THE ILLUMINATING ENGINEER

LIGHT
LAMPS
FITTINGS
AND
ILLUMINATION

THE JOURNAL OF

GOOD LIGHTING

Official Organ of the Illuminating Engineering Society

FOUNDED IN LONDON 1908

Edited by
LEON GASTER

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GAS
ELECTRICITY
ACETYLENE
PETROL-AIR
GAS
ETC.

Vol. XVIII | January, 1925 | Price NINEPENCE
Subscription 10/6 per annum, post free

Special Features:

Progress in Illuminating Engineering. —— New Electric Lamps and Lighting Appliances.—Advances in Gas Lighting.—Artificial Illumination of Tennis Courts.—Light and Vision.—Photometry.—Show-Window Lighting.—News from Abroad, etc.

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"The Illuminating Engineer"—Future Policy and Activities

WITH this issue *The Illuminating Engineer* commences a new stage in its existence. Since the journal was started in 1908 it has served primarily as a means of recording the proceedings of the Illuminating Engineering Society. The Society—as our esteemed first President, the late Professor Silvanus P. Thompson, happily phrased it—" has been engaged on a career of self-education." It has been collecting information and formulating principles of lighting, all of which have been duly recorded in the journal.

Now, after about eighteen years of pioneering work, it is felt that the time is ripe to extend our activities. The main principles of good illumination are well established. It is our task to make them as widely known as possible. By so doing we shall assist in carrying out the programme approved in the special Resolution passed unanimously at the Conference on Illuminating Engineering at Wembley on August 12th last year.

Accordingly the journal, while still continuing to act as the official organ of the Illuminating Engineering Society, is being extended so as to appeal to a wider circle of readers. The " Technical Section " will comprise the Transactions of the Society and special articles by contributors who are experts in their particular branch of illumination. The " Popular and Trade Section " will contain readable matter of general interest to Government Departments, Public Bodies and Kindred Societies, Contractors, Consumers and users of light on a large scale.

Another feature to which special attention will be paid is the publication of news from abroad. Illuminating Engineering is no longer confined to any one country. There are now Illuminating Engineering Societies in the United States, Japan, Germany and Austria, and in other countries interest in matters of illumination is growing rapidly.

The proceedings at the International Conference for the Study of Industrial Hygiene, and the meeting of the International Illumination Commission in Geneva last July showed how many are the subjects on which investigations are proceeding simultaneously in different countries. Our intention, therefore, is to keep our readers well posted on progress in illumination in all parts of the world and we are arranging to have the services of correspondents who are experts on lighting in practically all the chief cities of Europe and the United States.

Besides continuing to act as the official organ of the Illuminating Engineering Society the journal is prepared to serve as the channel for the dissemination of information on illumination from other bodies, by the exchange of papers and data, and other forms of mutual help. There are, for instance, societies interested in special aspects of lighting, in relation to accidents, smoke-prevention and the better utilization of sunlight, etc., problems of considerable interest to the Illuminating Engineer.

Illumination is a subject of direct interest to all members of the community. It is a subject on which the expert and the user of light can combine their efforts towards the solution of the problem " What is good Lighting ? " We shall welcome suggestions and aid from anyone interested in the question of promoting better public appreciation of the benefits of good illumination. This is a field in which all can co-operate.

Lastly, we would like to mention that, owing to special circumstances, the decision to inaugurate *The Illuminating Engineer* in its new form was necessarily taken somewhat suddenly, so that there has been insufficient time to complete all our arrangements for the future. We shall aim at embodying improvements as we proceed, and obtaining the support of all who can help us towards realizing our ideal of a technical and trade journal with a sound policy, of genuine educational value alike to the lighting industry and the general public.

1924—A Retrospect

Looking back over the past year, what are our conclusions regarding the development of Illuminating Engineering ? As regards progress in lamps and lighting appliances there is no very striking or revolutionary change to record—such as, for instance, the introduction of the gas-filled lamp or the incandescent mantle. But there has been a steady advance in methods of applying illuminants and in the perfection of details, both in gas and electrical illuminants.

One of the most outstanding factors has been the large amount of attention paid to lighting at various congresses, at Geneva, Bordeaux, and at Wembley. The internationalization of Illuminating Engineering still continues. Even where Illuminating Engineering Societies do not exist, we note a tendency towards better methods of lighting, and the crystallization of expert opinion on the main features of good illumination.

A natural result of this has been the general recognition that the time has come for more propaganda amongst the general public. Efforts in this direction in the United States were exemplified in the papers read by Messrs. Lieb, Powell and Merril, at the meeting of the International Illumination Commission in Geneva. In this country firms in the lighting industry have been developing educational work and demonstrations. A lead in this direction has been given by the E.L.M.A. Lighting Service Bureau, with its well-equipped demonstration hall. Leading gas companies are likewise perfecting their arrangements for approaching the consumer.

The chief point to be noted is that all sections of the lighting industry, as well as the public, benefit by a well-conceived movement of this kind. All sections should therefore do their share, co-operating in such a way as to present uniform data, and uniting in a common effort for the same cause—the advancement of better lighting.

Illuminating Engineering and the Press

At a meeting of the Circle of Scientific, Technical and Trade Journalists on December 18th, the writer had the pleasure of reading a paper on "The Position of England in the International Illuminating Engineering Movement and the Co-operation of the Press." The growth of the movement in this country and its ramifications abroad was traced. It was shown that interest in lighting is growing in all the chief countries; that it is more than ever important that this country should continue to play a leading part in these activities.

In referring to progress during recent years we have frequently emphasized the great services which the daily and technical press can render in bringing home to the public the importance of good lighting, and conveying in a readable form, conclusions arrived at in discussions of the Illuminating Engineering Society. From the very commencement full freedom has been given to journalists to comment on meetings of the Society, and everything possible has been done to put suitable information at their service. To this policy is to be ascribed the very extensive attention devoted to the Illuminating Engineering movement in the press, which we gratefully acknowledge and appreciate. Many of the problems with which we are concerned—the lighting of schools, streets and public buildings, etc.—are matters of national interest. At every point illumination touches our daily life, and affects health, safety, and efficiency. The press of this country can do national service by making this known.

We hope that all sections of the press will continue to look upon our journal and the Illuminating Engineering Society as sources of authoritative information on lighting. In the case of a rapidly developing subject such as illumination, discretion in referring to novelties is needed. Not every new invention presented can be said to justify the optimistic claims of the inventor so that it is useful for non-technical journals to have someone to whom they can turn for first-hand information on such matters. We shall, in the future as in the past, endeavour to be of assistance to all who seek our advice in this direction—bestowing every encouragement on scientific research and recording with appreciation genuine scientific progress.

The Lighting of the Home

Amidst more spectacular lighting developments the question of the lighting of the home is apt still to be relegated to the background. Yet the advances in electric load or greater gas consumption possible through the general adoption of a better standard of lighting in the home are very considerable; but they are only to be effectively secured by showing the consumer the benefits of better lighting and explaining in what "better lighting" consists. Consumers themselves do not sufficiently realize what a difference good lighting means to their comfort; it is as a rule only in the evening when the breadwinner and his family are together, that the comfort of home life is appreciated; and the whole appearance of the home depends on the way in which the light is managed.

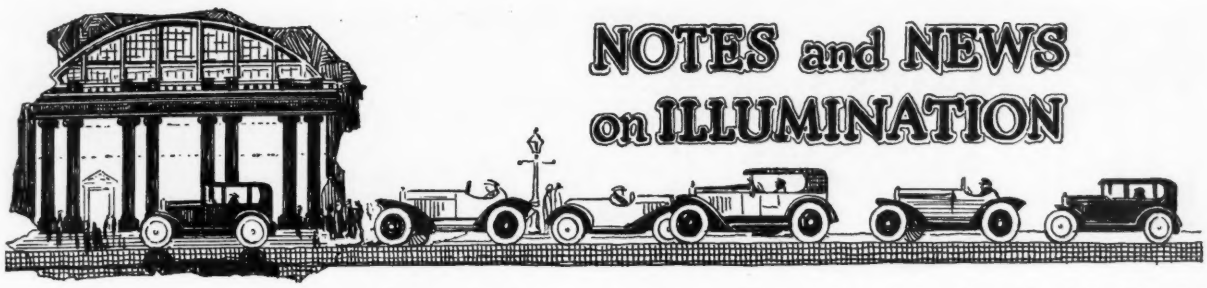
The lighting of the home is, in particular, a job in which women have an interest. Leading gas companies have for some time made use of the services of lady experts, and very efficient and successful some of them are. We notice with interest that the Women's Engineering Society has formed an offshoot consisting of women who are electrical engineers, and we understand that domestic lighting will receive special attention. We wish the ladies every success in their new venture and the writer, when present at their recent opening meeting, took the opportunity of assuring them that we would give them every support in their efforts to make the home a place of greater safety and comfort.

The Problem of Public Street Lighting

Various discussions during the past year have brought the problem of public lighting prominently forward. People are becoming conscious of the lost ground during the war, and the stagnation during the subsequent period of financial stringency. The leading thoroughfares of London, and some other cities would challenge comparison with any in the world. But many business streets, and roads which serve as arteries of traffic, are still badly lighted. We hope that in time to come every large city will have its properly qualified lighting engineer, and that lighting committees will give weight to his view in planning improvements. Too often an "improvement" consists merely in substituting lamps of higher power in existing lanterns; such makeshift devices are rarely completely satisfactory. They may furnish more light but do not achieve its proper distribution.

As we have often pointed out, the whole problem of street lighting has been changed by the rapid development of motor traffic. The growing number of accidents is naturally giving ground for concern, and there is good reason to believe that a large proportion of them are due to inadequate lighting. Public authorities cannot escape responsibility for accidents so caused; it is their duty to see that each street receives illumination adequate for the volume of traffic it has to carry.

Apart from the lighting of important streets in cities a new problem is presented by the special arterial roads connecting towns, now being constructed at considerable national expense. We hope that the proper lighting of such routes will receive careful attention from the authorities. Their efficiency by night depends very largely on the way they are illuminated, and this new problem only serves to show how true is the saying that public lighting is no longer a parochial matter, but a national one.



Playing Games by Artificial Light

The interesting article contributed by Mr. C. Rossander describing the lighting of the new tennis courts at Stockholm (p. 11) recalls the discussion on the above subject before the Illuminating Engineering Society in May, 1921. Football matches have taken place by artificial light. But the lighting of covered tennis courts is perhaps the most familiar example. We notice that the Edmonton Urban District Council is carrying out experiments on the artificial lighting of their hard courts. As Mr. Rossander points out, the problem is an intricate one, and the avoidance of inconvenient shadows and glare by no means easy. Some instances of artificial lighting of courts in London have not been too successful. We shall watch with interest the experiments at Edmonton.

Wembley in 1925

It has now been definitely decided that the British Empire Exhibition is to be reopened in 1925. It is stated that the authorities are already at work planning improvements. In a recent interview Sir Lawrence Weaver said that the general appearance of the Exhibition in 1925 ought to be much more beautiful. "The gardens will have matured, and the external lighting, which was admittedly indifferent in 1924, will be greatly increased in brilliance." We are glad to note that the authorities recognize the importance of better lighting. The causes of the defects were discussed at the Conference on Illuminating Engineering at Wembley in August last. We feel sure that the Illuminating Engineering Society would receive sympathetically overtures from the authorities to co-operate with them in making the lighting of the 1925 British Empire Exhibition worthy of the occasion.

Lighting Developments at the Zoo

Presiding at the annual festival at the Zoo, on Christmas Day, Dr. Charles Mitchell, Secretary of the Society, mentioned that the past year had been one of the most successful that the Zoo has had. This is ascribed largely to the new features added, including the Aquarium, opened in April last. The provision of "artificial daylight" for this Aquarium was a novel step. As a result it is regarded as "even pleasanter in winter than in summer." We note that extensions of the electric lighting are in prospect, and that a new cable for the purpose is being laid by the Marylebone Council. Apart from its value in rendering the Exhibition more attractive, the use of artificial light should render possible many interesting experiments, especially in regard to its influence on animals from tropical regions accustomed to days of approximately equal duration in summer and winter.

The Sheffield Illumination Society

An instance of the growing interest in lighting is afforded by the formation of the Sheffield Illumination Society for the benefit of members of the Corporation Lighting Department. Readers will recall that a similar body was formed under the auspices of the Glasgow Corporation Lighting Department, some years ago, and Sheffield is now falling into line. Public lighting is now coming to be regarded as a most important matter, and it is to be hoped that the time will come when every large city will have a properly qualified public lighting engineer. Meantime the formation of local societies for the benefit of the lighting staff will aid very greatly in disseminating information on lighting and furnishing men from whose ranks the public lighting engineers of the future should come. The Hon. President of the Society is Mr. J. F. Colquhoun (who is also a member of the Illuminating Engineering Society), and the Secretary, Mr. E. Marrison. A programme of meetings and visits has already been drawn up, and we wish the new venture every success.

Electricity from Wind-Power

Much interest has been expressed in an improved form of wind-power machine, developed as a result of tests at the Aerodynamical Institute at Göttingen. Windmills driving small dynamos are not unfamiliar in rural districts, and have been used for country house lighting with some success. The new machine is stated to be the result of scientific consideration of the principles operating in the case of wings of aeroplanes, and is based on suction of wind-currents rather than propulsion in the ordinary sense. It is claimed that the new form of windmill is much more efficient than the ordinary type, that it can utilize light currents of air such as are ordinarily ineffective, and that by means of a special projecting stay the speed can be regulated in the case of violent gales. All these would be considerable advantages, but the fundamental fact remains that wind-power is intermittent. Some means of storing power, i.e., a battery of accumulators, is needed. Therefore, whilst it may prove a valuable supplementary source of energy, it remains to be seen whether wind-power can be regarded as a permanent means of maintaining a supply of electricity for lighting and other purposes in agricultural districts.

New Electric Supply in Vienna

It is common knowledge that many hydro-electric schemes, bringing abundant supplies of electricity to towns and railways, have been initiated on the Continent during recent years. One such scheme has just been completed at Partenstein, near the Bavarian border, whence electricity is transmitted to Vienna, about 200 miles away. The energy is derived from the Mühl River. On the last day of 1924 the Town Hall of Vienna was brilliantly illuminated by thousands of electric lamps to mark the initiation of the new supply. This is only one of many great plants constructed in the vicinity of Vienna since the war, which it is estimated will ultimately furnish an additional 300,000 h.p., all generated hydraulically.

Forthcoming Events

The NEXT MEETING of the *Illuminating Engineering Society* will be held at the House of the Royal Society of Arts (18, John Street, Adelphi, W.C.), at 8 p.m. on TUESDAY, JANUARY 27TH, 1925, when a paper on *The Effect of Internal Obstructions on the Performance of a Lighting System* will be read by Mr. J. W. T. WALSH (Nat. Physical Laboratory).

Those desiring to attend are invited to communicate with the Hon. Secretary of the Society (Mr. L. Gaster, 32, Victoria Street, London, S.W. 1), from whom advance copies of the paper may be obtained.

Light Painting—an Aid to Industrial Illumination

Factory owners desirous of improving lighting conditions might do worse than consider one very simple means of improvement—the painting of walls and ceilings with light-coloured materials. A recent publication by the National Safety Council in the United States specifies nine beneficial effects. Light surroundings substantially increase the illumination available from a given number of lamps of certain candle-power, diminish tendency to glare, promote better diffusion and soften shadows. The increase in illumination by merely re-painting stained and discoloured walls and ceilings is often remarkable. But the introduction of bulky dark-coloured machinery, by obstructing the light diffused from such surfaces, lessens this benefit. Hence, some up-to-date manufacturers also paint portions of machinery in a light colour. For this purpose white is probably not desirable, as the contrast with the material worked upon is too great and causes it to appear underlighted. A light grey colour seems to be preferable in such cases.

Show-Window Lighting in Germany

From a paper read by Dr. H. Lux before the German Illuminating Engineering Society, it appears that progress in shop-window lighting in that country is following lines generally similar to those in England. Some pleasing photographs illustrating concealed lighting are reproduced. One point of interest raised by Dr. Lux is the choice of reflectors. Those of a polished or semi-polished character are doubtless most efficient, but some window-dressers prefer a dead white surface, believing that better diffusion and a softer light is thus secured. Makers of lighting appliances can supply either variety and the choice probably depends on circumstances. In a high and shallow window, where concentration of light is important, some degree of polish in the reflector-surface seems essential. But when the depth of the window is considerable, and a " soft light " is aimed at a diffusing surface may have advantages.

The "Drawing Power" of Shop-Windows

Many tests have been reported proving that a well-lighted show-window has increased drawing power. A recent test in the United States was, however, conducted on somewhat novel lines, the idea being to see whether the pull of a well-lighted window was sufficient to induce people to leave the beaten track. A shoe store, a jewellery store and a chemist's and a draper's, which were on the unfrequented side of a street—the other side containing a popular theatre—were specially lighted with an illumination of 100 foot-candles, colour and " spot-lighting " effects being provided. During two weeks' observation it was found that the number of people using the " unfrequented " side of the street increased by 51.4 per cent., while during the theatre periods the increase was 63 per cent.

Courses in Gas Engineering

A notable step is mentioned in the Report of Progress presented before the American Illuminating Engineering Society at the recent Annual Convention—namely, the establishment at the Johns Hopkins University of a Chair in Gas Engineering. It may be recalled that industrial gas courses have been arranged at other educational centres in the past. But the permanent establishment of this department at the Johns Hopkins University is a new step. No doubt the course will include instruction in illuminating engineering, with gas as a special item. In the United States, as in this country, it is now recognized that lighting forms a most valuable and important section of the gas industry.

Regulations for Motor-Headlights in France

In view of the discussion that has been proceeding in this country in regard to regulations for motor headlights, developments in France are of special interest. A report presented at the meeting of the International Illuminating Commission by Mons. P. Bossu (President of the Commission des Projecteurs d'Automobile du Committé Français de l'Eclairage) reviewed the problem very fully, in particular the regulations of the Ministère des Travaux issued in 1923. This report allowed motorists to use headlights of any desired power when the route is free, limitations only being imposed when the illumination 100 metres ahead of the vehicle from public lamps is sufficient. Tests made in the Bois du Bologne suggest that 0.05 lux* at a distance of 100 metres meets ordinary requirements. This illumination, if not provided by public lighting, is easily exceeded by most forms of headlights. Mons. Bossu also draws a distinction between the intensities of illumination required from headlights by various vehicles, according as they fall into three classes—slow, fast, and very fast.

Lighting Developments in Holland

Holland, it may be recalled, enjoys the distinction of being one of the very first countries to include good lighting in the requirements specified in its Factory Act. Values of illumination in *lux* for various industrial processes were specified many years ago. Although at present there is no Illuminating Engineering Society in Holland, this country in common with others, is taking a keen interest in lighting problems. A correspondent informs us that in the course of a recent visit to Amsterdam he was struck by the uniform high standard, especially exemplified in the lighting of shop windows.

* Approximately 0.005 foot-candles.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Progress in Illuminating Engineering

Proceedings at the opening meeting, held at the House of the Royal Society of Arts, 18, John Street, Adelphi, London, W.C., at 8 p.m., on Tuesday, November 18th, 1924.

THE opening meeting of the Session was held at the House of the Royal Society of Arts, 18, John Street, Adelphi, London, W.C., at 8 p.m. on Tuesday, November 18th, 1924, the chair being taken by DR. JAMES KERR.

The minutes of the last meeting having been taken as read the HON. SECRETARY read out the names of the following applicants for membership:—

Colquhoun, J. F. .Public Lighting Engineer, Sheffield Corporation, 42, Corporation Street, Sheffield.
Cunliffe, C. H. ...Electrical Engineer, 5, Longfield Road, Ealing.
Magnus, P. .....Magnus Lighting Service, 281-5, Collins Street, Melbourne, Australia.
Richards, D. S. ...Edison Swan Electric Co., Ltd., 50, Empress Avenue, Ilford.
Souza, V. de .....H.M. Office of Works, 37, Park Avenue, Bush Hill Park, Enfield.
Souter, W. T. F. .Illuminating Engineering Dept., Holophane Ltd., Elverton Street, Westminster, S.W.1.

THE CHAIRMAN then called upon MR. L. GASTER to present "Notes on Events during the Vacation," as follows:—

NOTES ON EVENTS DURING THE VACATION.

BY L. GASTER *(Hon. Secretary)*.

It is customary at the opening meeting of the session to give an account of progress during the vacation. Before proceeding to do so, however, I wish to refer to the loss which the Society has sustained in the death of one of its Vice-Presidents, Sir William Bayliss, F.R.S. Besides holding an eminent position as a physiologist, he took a great interest in the work of the Society, and participated in many of its investigations relating to the effect of light on vision. I have also to record with regret the death of Dr. E. L. Nichols, one of the earliest American physicists to identify himself with illuminating engineering, and the author of many brilliant researches in radiation and spectrophotometry. A suitable notice has already appeared in *The Illuminating Engineer*.

I should also like to take this opportunity of recalling that the Society commences this session under the Presidency of Mr. C. H. Wordingham, a past president of the Institution of Electrical Engineers, who has always taken a very keen interest in the work of our Society.

It is one of the chief features of our Society that its activities do not cease during the vacation, and that this period is commonly utilized for developing its work at congresses and international gatherings. The vacation this year has been a period of exceptional activity. There was first the sectional meeting of the World Power Conference held at the British Empire Exhibition on July 4th, when papers by Mr. J. W. T. Walsh, Mr. C. W. Sully, and the writer were read. Reference to the proceedings at this gathering has already been made in *The Illuminating Engineer*. It revealed a general recognition of the great opportunities before the lighting industry, and the need for organized and extensive efforts to interest the public in illumination.

THE INTERNATIONAL CONGRESS ON INDUSTRIAL HYGIENE (GENEVA).

Shortly after this event, a number of the members of the Society were present at two important gatherings in Geneva, the International Conference on Industrial Hygiene, held during July 18th to 20th, and the meeting of the International Illumination Commission immediately afterwards. At the Congress on Industrial Hygiene, which was held under the auspices of the University of Geneva, an excellent opportunity was presented of reviewing the claims of good industrial lighting.

Communications by Professor O. Oblath on "Ocular Fatigue," and by Dr. Stassen on "Miners' Nystagmus," contained frequent references to the prejudicial effects of inadequate lighting on sight, and the writer, in the course of a paper on industrial lighting, commended this subject to the special attention of experts on hygiene. Following the reading of this paper, a resolution was passed recommending that hygienists should co-operate with the Illuminating Engineering Societies in different countries, with a view to agreement on practical principles. The Congress revealed a general recognition that illumination ranks with proper heating, ventilation, etc., as an essential element in the health, safety and efficiency of works. It is hoped, therefore, that one important result of this conference will be the general acceptance of good lighting as a necessary hygienic measure, and the promotion of joint action by lighting experts and hygienists throughout the world.

Similar views were expressed in a paper presented by the writer at the Congress of the Royal Institute of Public Health, held in Bordeaux during June 4th to 9th. It was mentioned, as a gratifying circumstance, that the general principles in regard to legislation on factory lighting approved in England are also endorsed by leading authorities in France.

THE MEETING OF THE INTERNATIONAL ILLUMINATION COMMISSION.

At the meeting of the International Illumination Commission, held in Geneva in July, a large number of papers were read, an important departure being the attention devoted to the practical as well as the scientific side of illuminating engineering. From this standpoint, special importance was attached to the three papers by

Messrs. J. W. Lieb, G. S. Merril and A. L. Powell, describing methods of promoting public appreciation of the benefits of good lighting in the United States. Important points to be noted were the recognition of the Illuminating Engineering Society as the means of uniting the efforts of all sections of the lighting industry, and the expediency of arranging for researches on results of better lighting to be conducted under impartial and authoritative supervision so as to impress the general public.

THE CONFERENCE ON ILLUMINATING ENGINEERING AT WEMBLEY.

Following these important events was the Conference on Illuminating Engineering, arranged by the Society at the British Empire Exhibition, on August 12th. The opportunity was then taken to present a review of the proceedings at these conferences in Geneva. It was generally agreed that the time is ripe for joint educational efforts on a large scale, and the following resolution was passed unanimously:—

(1) That as a result of eighteen years of experience of Illuminating Engineering in this country and the United States, this conference considers that the time is ripe for comprehensive effort to promote public appreciation of the benefits of good lighting, and views with approval the desire of the Illuminating Engineering Society to prepare a suitable scheme for this purpose, with the co-operation of other bodies interested in various aspects of illumination.

(2) This Conference recommends that every support should be given by institutions for the encouragement of research, members of the public, and by all sections of the lighting industry to the Illuminating Engineering Society in carrying out such a scheme.

We are now engaged in preparing a suitable scheme which will include popular lectures and demonstrations, special courses in illuminating engineering at leading educational institutions, the publication of articles on lighting in the daily and technical Press, and especially the extension of *The Illuminating Engineer* so as to enable it to appeal to a larger section of the public.

Other papers of topical interest were read on this occasion, including that by Mr. E. F. H. Fryer on "Illumination of Highways from the Motorist's Standpoint"; and by Mr. G. L. Jennings and Mr. Haydn T. Harrison, who dealt respectively with the gas and electrically-lighted sections of the Exhibition. The two latter papers illustrated very aptly the impartial methods of the Society and led to an interesting discussion.

OTHER EVENTS OF INTEREST.

The growing interest in public lighting was exemplified by the proceedings at the First Annual Meeting of the Institution of Public Lighting Engineers and Superintendents, held in Glasgow in September, and the work of the Institution will doubtless be helpful in supplementing the efforts of the Illuminating Engineering Society to promote a better recognition of the importance of good public lighting, and the need for fully qualified lighting engineers in all important cities.

The Annual Convention of the American Illuminating Engineering Society was again the occasion of many interesting papers, and it is worthy of note that this year Austria has been added to the list of countries which have formed Illuminating Engineering Societies. It is evident that the movement is rapidly developing in all parts of the world, and that this country must make efforts to maintain its present position and take its proper share in these international deliberations. It is hoped that the improvement and extension of the official organ of the Society, which will include regular contributions from the considerable number of corresponding members in all parts of the world, will be of great benefit in this direction.

During the past few years the Society has been continuing to act as the "liason officer" between various bodies interested in illumination, and practically all such bodies are now represented on its council, an arrangement which has been found very helpful in promoting co-operation in matters of common interest. Another pleasant feature, marking the resumption of international activities, has been the constant succession of visitors from different countries (including Russia, Roumania, Sweden, Germany, and Japan), who have come to regard this Society as the centre for information on illumination.

Progress in Electric Lamps and Lighting Appliances

[*Report of the Committee on Progress in Electric Lamps and Lighting Appliances (Mr. S. H. Callow [Chairman], Mr. C. W. Sully, Mr. J. W. Elliott [Secretary], Mr. J. Y. Fletcher).*]

The usual Report of the Committee on Progress in Electric Lamps and Lighting Appliances was then presented by MR. C. HUGHES, in the absence of the Chairman (MR. S. H. CALLOW):—

GENERAL.

During the period under review, whilst there has been no outstanding development in the design of electric lamps, steady and continuous progress has been made in the use and application of electric lighting generally. This is particularly so with regard to the application of the newer types of lamps—the all-white lamp (both opal and sprayed types) and the colour-sprayed lamp—introduced at the period of the last report.

The education of the general public towards demanding higher standards of illumination has steadily progressed, and it is safe to say that the use of these higher illumination values will have a far-reaching effect on the commercial, industrial and social life of the community. In this connection it may be recorded that gas-filled lamps are rapidly replacing vacuum lamps, in all classes of lighting service.

The all-white lamp—both opal and sprayed enamel types—is rapidly gaining in popularity, and is being used in ever-increasing quantities for domestic, commercial and industrial lighting.

The sale of coloured-sprayed lamps has considerably increased. The introduction of this lamp has led to the development of colour-lighting schemes for theatres, cinemas, hotels, restaurants, etc., which have not hitherto been possible, and in addition their use is becoming increasingly popular for domestic lighting.

For the illumination of shop interiors and commercial premises generally, totally enclosed units are being installed in large numbers. The use of semi-indirect units for this class of work is rapidly on the decline. There is a marked tendency toward the use of higher standards of illumination in industry and commerce, indicating that the propaganda for better light is rapidly bearing fruit. Installations designed to give 10 foot-candles are frequently being installed. Many new types of decorative glassware are being introduced on the market. This is particularly noticeable in the domestic types, and the more common use of glassware of this character enables the gas-filled lamp to be used to better advantage in view of the better quality of the light which this combination gives.

There has been a considerable increase in the use of portable foot-candles meters of all types by all classes of buyers, both consumers and electrical engineers.

B.E.S.A. SPECIFICATION.

An important feature of the year's work has been the preparation and issue of the B.E.S.A. Specification No. 161 for normal type tungsten filament electric lamps. Considerable work was necessary in order to arrive at the conclusions given in the specification, and it was ultimately found possible to define standards for dimensions, light output and life for all the standard types. It is expected that the issue of this specification will render considerable service to the lamp-purchasing community.

Committees for the purposes of standardizing fittings and reflectors are now in being, and it is hoped that, as a result of their deliberations, standard practice for the more common types of lighting units will be established.

Street Lighting.

Considerable attention during the year has been given to the question of street lighting, and the first Annual Convention of the Association of Street Lighting Superintendents was held in Glasgow in September, when a number of interesting papers dealing with this important subject were discussed.

Some notable electrical street lighting installations have been made, one outstanding example being the lighting of a section of the Charing Cross district, where two fittings per lamp-post have been installed, each fitting containing a 1,500-watt gas-filled lamp. The intensity of the illumination provided by this system is probably the highest which has been recorded in any part of the world.

The use of white lamps for the illumination of streets has been found to reduce glare, and has been adopted in a number of districts.

Floodlighting.

The illumination of the exterior of buildings by means of floodlight projectors is being continued, and it is noticeable that the intensity of illumination for this purpose is taking an upward trend. In some instances colour lighting has been introduced to considerable advantage.

Shop Window Lighting.

Although large numbers of reflectors and lamps have been sold during the year for the illumination of shop windows, much work has still to be done toward the improvement of window lighting generally. As a result of the survey of 10,000 shop windows made during the year it was found that 66 per cent. are employing installations in which the filament of the lamp is visible, and only about 5 per cent. of the total of electrically-lighted shops are employing modern lighting system. Some progress is noticeable in regard to the use of colour and spot-lights for window lighting, and there are many indications that lighting of this character will be more freely adopted in the future.

Cinema Lighting.

The most outstanding feature in cinema lighting during the period has been the development of colour-lighting effects. The most modern methods favour concealed lighting for lighting the dome or ceiling over the auditorium, in conjunction with decorative lighting from fixtures round the walls of the building.

Theatre Lighting.

Stage lighting technique has made increasing demands on the stage lighting engineer, and modern methods, rendered possible by the gas-filled lamp, enable such illusions as bright sunshine, dark and cloudy days, moving clouds, and even thunderstorms with lightning effects to be produced with every similitude to nature. The intensity of illumination for ordinary stage work has also increased.

Pageant Lighting.

Electric lighting has been employed with great success for the decorative lighting of pageants, military tattoos, etc., battery lamps being utilized for this purpose. In addition to the decorative lighting of vehicles, etc., battery lamps have proved useful for the illumination of music stands for bands, etc.

Seaside Decorative Lighting.

Until this present season the lighting of pleasure beaches, promenades, etc., has not had the full attention it deserves. Progressive seaside authorities, however, have realized how greatly the amenities of the resort can be increased by decorative lighting, and large numbers of colour-sprayed lamps have been used for this purpose. It has been found that colour-sprayed lamps successfully withstand the action of sea water and the generally bad climatic conditions experienced during the past year.

Sign Lighting.

The use of illuminated signs for advertising has greatly increased, and many novel lighting effects have been achieved by the use of colour-sprayed and daylight-blue lamps. The use of " Neon " tubes for decorative lighting and signs, has shown progress, particularly in the London area.

Outdoor Sports Lighting.

An interesting installation was carried out during the year on a football field. This consisted of flood-lighting the ground by means of gas-filled lamps and angle reflectors, the intensity of light being sufficiently high to enable the game to proceed with ease, and the fact that a photograph of the kick-off was taken will give some indication of the efficiency of the installation.

The British Empire Exhibition.

The great event of the year was the British Empire Exhibition, which opened in April and closed on November 1st. For the illumination of the exhibition halls and grounds many thousands of electric lamps were used, and particular mention should be made of the fact that flood-lighting projectors were installed to illuminate the facias of the principal buildings. Many thousands of colour-sprayed lamps were installed for the illumination of the grounds, and other special lighting features were introduced such as colour flood-lighting of trees.

During the period of the exhibition, a World Power Conference was held at which outstanding engineering problems were discussed. Papers dealing with electrical illumination were presented by various members of the electrical industry.

At the Electrical Development Association exhibit, a section was devoted exclusively to lighting. Automatic exhibits showing good and bad lighting practice were in constant operation throughout the whole period. The window lighting demonstration was of particular interest, and presented in a new and novel manner various forms of window lighting. A similar automatic exhibit emphasized the difference between good and bad practice in lighting the home. In addition, many novel features for the lighting of stands were introduced, including a free use of coloured illumination both for the fronts of the stalls and the stand interiors.

Incorporated Municipal Electrical Association Convention.

During the Convention of the Incorporated Municipal Electrical Association at Chester in June, a lighting exhibit was arranged, consisting of a seven-roomed interior in which all modern domestic lighting effects were introduced. In conjunction with this exhibit a demonstration lecture-room was arranged, together with an automatic window lighting exhibit. This latter exhibit demonstrated modern systems of high intensity white lighting, display colour lighting and selective spot-lighting.

The E.L.M.A. Lighting Service Bureau.

During the year the Electric Lamp Manufacturers' Association established a Lighting Service Bureau with complete demonstration rooms in London. Numerous meetings have been held, at which the principles of modern electric lighting have been presented to the visitors in a new and novel form. In addition to the work of the Association in London, numerous demonstration lectures have been given in the provinces, and lighting exhibits arranged at some of the more important provincial exhibitions. Advantage is being taken of this demonstration service by all sections of the electrical industry, and as a result considerable interest is being shown in all parts of the country in the Better Lighting movement.

Railway Station Roof Lighting

By A. CUNNINGTON

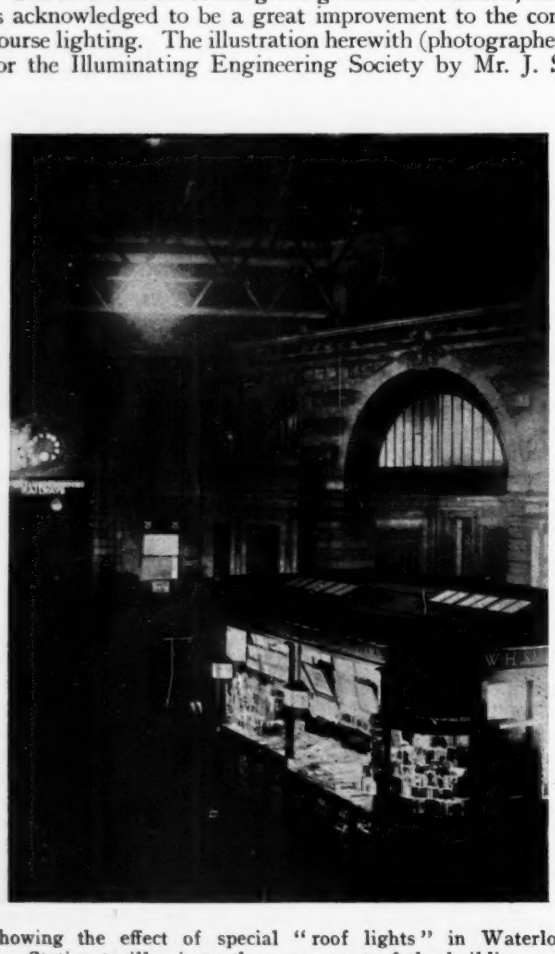
A note on Railway Station Roof Lighting was presented by Mr. A. Cunnington, as follows:—

IT has long been realized that much of the architectural effect of the roof and upper stonework of the buildings in many of our terminal stations is lost owing to the concentration of illumination on the concourse and platforms, which leaves an appearance of gloom throughout the upper part of the station. Mr. Roger Smith, in a discussion on Railway Lighting before the Illuminating Engineering Society in December, 1911, drew attention to this point and advocated sparing a small percentage of light to illuminate the roof (see Illuminating Engineer, Vol. 5, 1912, page 88).

For reasons of economy it is necessary to give first consideration to the lighting at platform level where the light is actually required, but there is also much to be said for providing some illumination which is not directly useful but which had a psychological effect by giving a more cheerful appearance to the station, and it was with this in view that authority was recently given for lighting up the station roof over the concourse at Waterloo, and this is believed to be the first attempt to deal independently with the lighting of a station roof.

The scheme adopted by the Lighting Department after careful consideration and trials of various devices, was to fix lamps at intervals close up to the roof principals and entirely unequipped with reflectors so that the light should be distributed in all directions. This effect has been heightened by the use of opalescent glass in the lamp bulbs, which has the additional effect of avoiding the glare that would otherwise arise from bare lamp filaments.

The resultant effect has given general satisfaction, and is acknowledged to be a great improvement to the concourse lighting. The illustration herewith (photographed for the Illuminating Engineering Society by Mr. J. S. Dow) was taken entirely by artificial light, and shows how the new lighting throws into relief the features of the steelwork in the roof and the stonework in the neighbourhood of the Memorial Arch. This is typical of the effect produced all over the concourse.



Showing the effect of special "roof lights" in Waterloo Station to illuminate the upper part of the building.

Progress in Gas Lighting

By J. G. CLARK

IT is customary at the opening meeting of the session to review briefly the progress made in lighting during the year. With regard to gas lighting, Mr. J. G. Clark, of the Gas Light and Coke Company, said that throughout the year there had been steady progress along well-understood lines. Perhaps the best way to consider this would be to see what gas did at the British Empire Exhibition at Wembley. Several things of interest in regard to gas lighting occurred there. The Amusements Park, for instance, was illuminated by incandescent gas lamps, and it had been generally agreed that the installation was a complete success. Increased interest was being taken in distance control of gas lighting; and it was likely that this method of regulating gas burners would become more popular. There was also the extended use of silica ware. This remarkable material had two important properties—first, the low co-efficient of expansion, which enabled it to withstand great variations of temperature without cracking; and secondly, the high degree of diffusing power, which rendered the light perfectly satisfactory without further shading. There had been introduced an improved form of glass as transparent as any ordinary clear glass, but having a low co-efficient of expansion, which allowed of its use at very high temperatures. This glass was used in a new form of Keith high-pressure lamp which was constructed on lines much smaller than those used hitherto. A lamp that yielded 1500 c.p. need be no larger than one yielding only 750 c.p. in the older form of construction.

He ought also to mention the extended and successful adoption of the cluster burner for street lighting. The principle of this burner enabled a high lighting efficiency to be obtained from gas at ordinary pressure, so that there was practically no limit to the extent of its application. Another outstanding feature of the past year was the increasing popularity of certain well-designed burners which have been placed on the market at a low price. Though these were cheap, they were perfect in regard to the essential features; and he hoped in time they would render the existence of the cheap and shoddy burners impossible. Shoddy burners were extravagant in gas consumption, inefficient in working, poorly made, and in the end proved very expensive appliances to the people who purchased them. The modernizing of school lighting was another item of interest during the past year or so. It was a matter upon which the Society could congratulate themselves, considering the pioneer work done by the members many years ago. It was pleasant to record the increased and increasing interest, on the part of those responsible for the working of industrial concerns, in the use of shades. On the question of propaganda, Mr. Clark mentioned that to his knowledge the members of the gas industry had spared no effort to make popular the principles of good lighting. Not only had this been done through the usual channels, but headmasters of schools had invited occasional lectures to their boys. This form of propaganda was probably as productive of good results as any.

The Psychology of Illumination

A SHORT address on the above subject was delivered by Mr. W. G. RAFFE, who introduced his subject by remarking that " Light is Life " ; without life there is none. In the absence of sunlight adequate artificial illumination was necessary. Much had been written regarding the need for good artificial light in order to carry on our daily work. But light affected all the activities of the body, the emotions and the mind. Full normal light, in the normal healthy being, makes for full pleasure in existence; the absence of it retards pleasure and efficiency. In the case of an abnormal person, treatment must be by abnormal lighting conditions. This has led to the establishment of " colour-clinics."

Physical vision is normally at best centring on green, with a balance between red and violet. Excess at either end of the spectrum disturbs the balance—by increased heat in the red and increased chemical activity in the violet. The pleasure derived from harmonious colours has a biological origin. The eyes can also derive pleasure from the simulating effect of strong colour or brightness, provided there is not excess. But if the vision is poor, or the stimulant is excessive, the effect is to produce irritation. Then trouble follows. Hence the need for judgment in the use of bright lights, for example in the form of luminous signs.

Light, Mr. Raffé added, is a pointer, an indicator. As the flower turns towards the sun so the instinctive actions of the body are determined by light. Light should be used to a greater extent in the churches of to-day. The red-yellow end of the spectrum stimulates and expands whilst the blue end has a sedative effect and contracts. Colours associated with night are mainly situated in the blue and violet end of the spectrum; " day colours " include mainly the red and orange.

The effect of light on the mind is partly sensory and partly by associated memories; hence it is never identical on all persons—any more than drugs or food affect all people alike. But there is a general similarity in effect amongst normal persons of one people.

Stage Lighting in Connection with Music

MISS MARY WURM, in a short talk on the above subject, recalled the discussion on Stage Lighting which appeared in *The Illuminating Engineer* in 1919. Mr. B. Fagan, who opened this discussion, had pointed out the fundamental importance of suitable lighting in stage production, and foresaw the time when the electrician would be an artist as well as a technical expert, controlling the illumination in tune with the unfolding of the drama.

METHODS IN THE DRESDEN OPERA HOUSE.

At that time, Miss Wurm stated, she was acting as solo-rehearser (correpetiteur) at the Dresden Opera. She had to carry out the written instructions of Mr. Haseit in conveying to the operators the exact moment at which certain lighting effects were required. She was the first woman who had acted in this capacity at Dresden. With the exception of Bayreuth there was probably no Opera House where so much attention was paid to the lighting effects as at Dresden.

It appeared that in England the illuminating engineer was often called in for consultation almost at the last moment. At Dresden he and the musical Stage Manager worked together. The Lighting Director received a musical score on which indications of lighting effects were indicated by pencilled instructions. Many " lighting rehearsals " took place. If, in this country, there should ever be a National Opera, the best available illuminating engineer should be engaged, for without this full success was unattainable.

CONCERT HALL LIGHTING.

Miss Wurm then proceeded to give instances of operas in which special lighting effects were obtained. She also raised the question why as yet the illuminating engineer's services had not been sufficiently utilized in connection with the concert platform. Solo-performers, especially pianists, were often at a great disadvantage owing to imperfect lighting arrangements. Sometimes, for instance, there was intense glare of light on the keys so that one had the greatest difficulty in distinguishing one key from another. The lighting up of the performer also deserved attention. Pianists were under the drawback that only their profiles were seen; violin-players and singers were in a somewhat better position as they faced the audience full face.

COLOUR AND MUSIC.

Finally, Miss Wurm pointed out that Music and Light, the two effects to which the ear and the eye reacted, were closely related. Colours do actually suggest musical sounds, and vice versa musical sounds suggest colour. Some time ago she had in mind a " colour music pianoforte recital." She would like to play certain works of Chopin, Debussy, Schumann, Beethoven and others with an accompaniment of light designed by the illuminating engineer. She outlined a suitable programme and looked forward to the time when we should simultaneously " hear Colour and see Music."

New Lamps and Lighting Appliances*

FOLLOWING the above reports and papers some novel types of lamps and lighting units were exhibited.

MAJOR A. GARRARD gave a demonstration of the " Moonbeam " motor-car headlight, in which the beam of light is confined below a certain plane above the roadway, so as to limit the " dazzling " of the eyes of persons approaching the vehicle.

MR. T. E. RITCHIE (General Electric Co., Ltd.) exhibited a new form street lighting lantern of special design, a feature being the special arrangements for ventilation and the use of a refractor to obtain the desired distribution for public lighting.

MR. L. E. BUCKELL showed some of the latest types of colour sprayed lamps, and MR. H. E. IVES (Benjamin Electric Ltd.) showed some new types of fittings giving a wide distribution of light and incorporating a diffusing band to check glare.

MR. MILLNER (British Thomson, Houston Co., Ltd.) showed a form of lighting unit with a " pierced " reflector devised to avoid the drawback that concentration of light downwards by an opaque reflector is apt to leave the upper part of the room in darkness. The latest form of " trough reflector " for show window lighting was also shown.

Finally MR. T. E. RUTHVEN MURRAY showed a form of motor-car number-plate constructed of plate-glass, illuminated by means of internal reflection, and capable of being operated with a 3 watt lamp.

After a vote of thanks had been passed to the various speakers and exhibitors it was announced that the NEXT MEETING would be held, by kind invitation, at the E.L.M.A. Lighting Service Bureau on Tuesday, December 16th. The opportunity would be taken to demonstrate and discuss in fuller detail Progress in Electric Lamps and Lighting Appliances, as outlined in the Report presented at the opening meeting. Early in the New Year it was hoped to hold a similar meeting dealing with Progress in Gas Lighting.

* For a fuller description of these exhibits see pp. 13-15.

Lighting and Tobacco

By Dr. JAMES KERR

A MIDDLE-AGED man will look up from a newspaper with a complaint of the electric light, or else it is "these incandescent burners are very irritating to the eye."

Anyone complaining of increasing inability to read, in the second half of life, is most likely feeling the natural changes—*anno domini*—presbyopia, which should be completely relieved by proper reading glasses. If these fail disease is present. As this may be the earliest sign of general disease an ophthalmic adviser should be sought.

One very common condition, which may exist in slight degree, and yet affect efficiency, is the so-called tobacco amblyopia or tobacco blindness. It can become serious in time.

The little patch called the macula at the centre of the retina at the back of the eye is extraordinarily sensitive, and has a separate nerve supply. This patch receives the image of the exact object looked at. The macular nerves are the first to fail as the result of chronic tobacco poisoning.

One can demonstrate this little patch for themselves. Make a small dot or mark on a newspaper, hold this up a foot off, and covering one eye, fix the vision of the other eye on the small mark. If the gaze is maintained steadily the only letters distinguishable are around the mark, and the area in which they are clearly seen could be covered by a shilling. When the macular nerves become affected they first fail in distinguishing red and green over this little area, and consequently these colours in small objects looked at are not clear. Just at the centre of this little area even the sense of white light may fail, so that the exact letter looked at is not perceived.

At first the other eye may be of a little service in helping out the vision, two eyes being better than one, but as the condition increases, even with both being used, vision is a little defective. Any tests then are more sensitive, and show the condition earlier if only one eye is used at a time.

How does this condition affect people? Usually the sufferers are aged 45 to 55, although the writer has met the condition in a miner of 26 who had smoked half an ounce of thick twist daily for two years. It is rare in women, but one dame of 46, whose vision could not be improved by glasses, and who had no other evidence of disease, after stoutly denying, confessed that no one knew that she smoked, as she was in the habit of smoking daily a few pipes, taking a pinch from each of the pouches left at home by her husband and three sons.

The condition comes on painlessly, always in a smoker. Usually three ounces or more in the week of twist, shag, honeydew, thick, dark and heavy tobaccos, are accounted for. It is not a necessary result, as people are seen for other eye troubles who smoke from three to five ounces without this particular amblyopia appearing. Generally a good deal of alcohol is also taken, and often there has been some slight stomach trouble. But Australian horses who eat wild tobacco get the tobacco blindness without being alcoholics.

Most of the men who get it have had good distant vision; three-quarters of them being long-sighted (hypermetropic). They notice that they do not see so well at times; some say they see worse in the mornings, others put it the other way about and say they see better in the dusk. A quarter of them first complain of difficulties with the newspaper, and another quarter of dimness or cloudiness; many speak of the blaze of light in the middle of the day, some see things shimmering. A printer complained that the bright linotype metal had damaged his eyes, so that he could no longer read the type faces on it. A teacher, before the war, complained that he could not distinguish a sixpence from a half-sovereign. The failure with reds causes people's faces to look smudgy and indistinct. One distinguished man of science, complaining of the quality of the electric light, said it was almost impossible to see red ink figures by it. He was told to reduce the perennial cigar to an occasional cigarette, and soon recovered.

It is this failure of colour which affords a ready test. Anyone complaining of the quality of the artificial lighting, and adding some of the foregoing experiences, haze, shimmering, difficulty with faces, bright metal, red ink, and so on, should have one eye at a time tested for small coloured objects. Give them a few coloured beads on a saucer, and ask them, using one eye only, to pick out the green and then the red beads. If they fail, ask about tobacco. It will not be the lighting that is at fault.

Or another ready test is a couple of pins. The head of one has been dipped in scarlet sealing wax, the other in bright green. Hold one up about eight or ten inches from the eye, the other eye being covered. What colour is that? If red, they will probably say brown, drab, or gold. Then try the green-headed pin. This will be called yellow, white, grey, or silver. With doubt of any kind try the other eye. If the colours are not easily distinguished by either eye at once, then, if the complainant is a smoker, it is time the quantity of tobacco is reduced. Cutting off the tobacco usually results in complete recovery in two or three months. Resumption of tobacco often means relapse, or the relapse may be postponed till some illness, like an attack of influenza, brings a strain on the nerves.

It was curious how well the Army escaped tobacco amblyopia in the war. Probably the fresh air, healthy activity, youth, and extensive use of cigarettes, instead of heavy tobacco in pipes, was the chief reason.

Once the condition is suspected it is surprising how prevalent slight cases will be found. Common enough to justify one in asking a man with spectacles who complains of the quality of artificial lighting how much he smokes. Tobacco may be a friend, but only in moderation.

Inadequate Lighting and Defective Vision

IN a paper on "Physio-therapy of Ocular Vision," read at the meeting of the Internal Congress on Industrial Hygiene held in Geneva last July, PROF. G. OBLATH showed how defects of vision and conditions of illumination necessary for various employments are closely related.

Amongst the direct causes of ocular fatigue he places intensity of light at the head of the list. Deficient illumination is of the first importance, as it causes the workman to approach too near to his work, and so affects his convergence and accommodation, and finally his whole visual apparatus. Thus workmen in a plaster mine at Baden were found to be suffering from various forms of ocular fatigue and disordered visual apparatus —all of which disappeared when the illumination was improved. Glare must also be considered. Irregular contractions of the pupil produced by too intense a source of light deprives the eye of part of its natural protection. Cinematographic artists are liable to suffer from ocular troubles owing to their incautious exposure to intense visible light or ultra-violet rays. In the case of glass-workers intense exposure to infra-red rays may likewise cause trouble.

Amongst indirect causes of fatigue, the concentrated attention necessary for some forms of work (e.g., that of engine drivers and chauffeurs) is of importance. Very fine work, such as that of tailors, watchmakers, etc., is also liable to cause fatigue. It is of great importance that the individual should not be allowed to select a profession for which his visual field, fusion capacity and light and colour sense are not sufficiently good. School doctors should be consulted on the choice of profession for children on leaving their studies. Ocular fatigue may also be minimized by careful examination of persons and the correction of errors of refraction. In work necessitating minuteness and rapidity, frequent interruption is an efficacious means of preventing ocular fatigue.

The Indirect Lighting of a Lawn Tennis Court in Stockholm

By G. A. ROSSANDER

(Consulting Engineer, Elektriska Pröfningsanstalten, Stockholm).

THE problem of the provision of artificial light to enable games to be played by night has been the subject of much discussion in *The Illuminating Engineer*, and some notes on the lighting of a new tennis hall in Stockholm, may therefore be of interest.

The problem of providing suitable artificial light for a new tennis court is, as was pointed out in the discussion referred to above, a somewhat intricate one. One has not merely to furnish ample and uniform illumination on the court surface; one must also take special precautions to eliminate glare. The general scheme for the lighting of this building was drawn up by the well-known architect, Mr. T. Grut, who is himself a keen lawn tennis player. The calculations and the design of the fixtures were worked out by the author with the aid of Mr. C. A. Stedt, of the Elektriska Pröfningsanstalten.

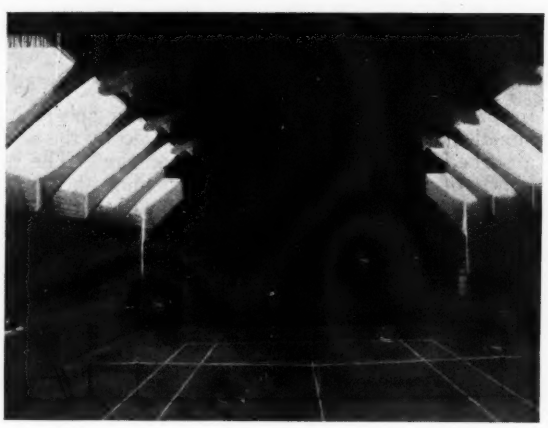


FIG. 1.—General View of Hall.

The ceiling as well as the floors being dark in tint, it was necessary to furnish the lamps with special extensive over-reflectors. Beneath each lamp there is a small, almost hemispherical reflector, composed of copper, nickel-plated inside. The upper reflector is approximately one and a half metres in diameter, made of zinc sheet, and painted white on the reflecting side. The reflectors are so designed, and their position so selected, as to direct as great a proportion as possible of the flux of light on the surface of the court. There are twelve 1000 watt. 220 v. lamps (yielding each 1550 Hefner candles, i.e., about 1350 c.p.).

FIG. 2.—A Close View of Lighting Unit.

Figure 1 shows a general view of the hall. It will be observed that the reflectors are so distributed that the light comes from the same direction as the natural light. The individual fitting is shown in Figure 2. A feature of its construction is that a player looking upwards sees no direct light, but only the diffusing surface of the upper reflector, which is of very moderate brilliancy. (The photographs were taken by daylight, the season of the year being inconvenient for taking views by artificial illumination.)

The system of light is considered to be a complete success. Players agree that the courts are remarkably well lit. The total consumption of energy is 12,000 watts, roughly 17.5 watts per square metre.* The cost of the energy is about 4 Swedish Crowns (about 4/6) per hour. Personally I think that the illumination is somewhat higher than is strictly necessary and could be reduced, by inserting smaller lamps, without inconvenience to the players. It is of interest to have some idea of the intensity of illumination, and accordingly careful measurements have been carried out under the author's instructions by a former student at the Stockholm Polytechnic High School, Mr. E. Holmquist. The curves obtained showed that the illumination throughout the hall was very uniform. The average illumination over the whole floor was 77.8 lux (about 6 foot-candles), and on the actual court 94.6 (approx. 8 foot-candles). The area illuminated measured about 686 square metres so that the utilization efficiency of the installation is:—

$$\frac{77.8 \times 686}{4\pi} .100 = 23 \text{ per cent.}$$

In view of the fact that, as mentioned above, the ceiling walls and floor are all quite dark in colour, this must be regarded as a very satisfactory efficiency.

Playing Golf by Artificial Light

ANOTHER striking instance of the use of artificial light to enable games to be played at night is afforded by the arrangements made at the golf course at Briercliffe Lodge, N.Y., where the recent Convention of the American Illuminating Engineering Society was held. The fairway and putting green were strongly illuminated by masses of 1,000-watt projectors set on either side of the fairway and at suitable distances from the green. But—what seems to have been a happy inspiration—additional flood lighting units were used to illuminate the foliage of adjacent trees in varied tints, thus relieving what would otherwise have been a severe contrast between the brightly lighted course and the surroundings. Matters were so arranged that no light-sources were visible to the players, and the effect is described as very restful and pleasing.

In a paper describing the arrangements, Mr. W. T. Dempsey stated that in driving from the tee the ball could be clearly seen throughout the whole 740 feet from the tee to the green. Values of 6 to 10 foot-candles were recorded on the green and this was ample to enable putting to be undertaken with ease. It is stated that about 27 kW. was expended in lighting the entire fairway and green.

The original paper is illustrated by day and night photographs of the area lighted, and one view shows Gene Sarazon putting on the first green, both players and spectators being clearly visible.

The November issue of the *Transactions* of the Illuminating Engineering Society (U.S.A.), which contains the description of this installation, also refers to another development, the use of artificial light to expedite the growth of grass on a new golf course at Bradley Beach. At the end of six weeks the illuminated grass had grown six inches, where adjacent unlighted grass was only one inch high. The green was ready within two months, as compared with an ordinary period of preparation of at least a year.

* Roughly 1.5 watts per square foot.

Notes for the Photometric Laboratory

(I) The Integrating Sphere

By JOHN W. T. WALSH, M.A., M.Sc., F.Inst.P., A.M.I.E.E.
(from The National Physical Laboratory.)

The Importance of Flux Measurement.

At the time when the spatial light distribution of the light sources in common use was more or less definite, a measurement of candle-power in a fixed direction or, more frequently, the average value of the candle-power in all directions lying in a single defined plane, was a sufficiently good basis for the comparison of different sources. Thus for the metal filament vacuum lamp with its filament in the form of a "squirrel-cage," or for the upright incandescent gas mantle, the mean horizontal candle-power bore a ratio to the mean spherical candle-power which was sufficiently constant for practical purposes. Modern developments in both gas and electric light sources have, however, completely altered this position, and for such sources the only fair figure of comparison is the mean spherical candle-power or, what is in effect the same thing, the flux output in lumens.* This has been definitely recognized in the latest edition of the British Standard Specification for Tungsten Lamps (B.E.S.A. Spec. 161 of 1924), in which the basis adopted for all photometric measurements is the mean spherical candle-power or the luminous flux.

Since the measurement of this quantity can be carried out conveniently only in some form of photometric integrator, such as the sphere, the importance of the correct use of this type of apparatus is at once apparent.

The Integrating Sphere.

In the present article the integrator will be assumed to have the spherical form. Other types of integrators such as the cube, icosahedron, etc., will be dealt with in a later note. The theory of the sphere has been very completely described in a number of articles† and in a book by R. Ulbricht‡ dealing with the whole subject. It will not be touched upon here. The object of the present note is to describe briefly, and in more or less general terms, the precautions which must be observed in measuring one particular type of source, viz., the electric incandescent filament lamp. It will be assumed that the substitution method of measurement is employed. In this method the substandard is first placed as nearly as possible in the centre of the sphere and a measurement proportional to the brightness of the sphere window, B_s, is made. The test lamp is then substituted for the substandard and a second measurement of brightness, B_T, is made. The mean spherical candle-power of the test lamp, I_T, is then deduced from that of the substandard, I_s, by the relation $I_T/I_s = B_T/B_s$.

There are three principal factors which affect the correctness of this formula as applied to any particular case. These are (i) the size and position of the screen used to prevent the sphere window from receiving any direct light from the source, (ii) the reflection factor and colour of the paint used to coat the interior of the sphere, and (iii) the size and nature of the source and its necessary auxiliary apparatus. These factors will be considered in turn.

The Screen.

The size of screen used necessarily depends on the size of the sphere window and of the source of light, i.e., in the case considered, the filament and its image produced by reflection from the walls of the glass bulb. As a general rule it may be stated that the diameter of the window should not exceed one-tenth of the diameter of the sphere. The screen should be at a distance from the window equal to $\frac{2}{3}$R where R is the radius of the sphere* The screen should be as small as possible, consistent with complete shading of the window from direct light. The screen should be opaque and both it and its supports should be painted all over with the paint used for coating the sphere. The error introduced by the presence of the screen is negligible so long as the test source and substandard have approximately the same light distribution, and this is an ideal which should always be aimed at. For the magnitude of the error introduced when this condition is not fulfilled, the paper by Chaney and Clark quoted above should be consulted. As an example it may be said that in the case of a vacuum squirrel-cage filament type of substandard and a gas-filled ring filament type of test lamp, the measured candle-power of the latter will be about 0.25 per cent. in excess of its true value, assuming the radius of the screen to be R/10, the reflection factor of the sphere paint 80 per cent., and the reduction factors for the two lamps 0.78 and 1.05 respectively.

The Effect of Flux Absorption by the Source.

In the simple theory of the integrating sphere it is assumed that none of the light flux emitted by the source is absorbed except at the walls of the sphere. The very presence of a source of finite dimensions and of the supports, etc., necessary to operate it within the sphere violate the ideal conditions and introduce a possibility of error. Flux is absorbed by the supporting structure, leads, lamp socket and cap, and by the glass bulb itself, especially if this be at all blackened. The loss can be minimised by covering everything inside the sphere (except, of course, the bulb) with a white material. Supports, leads and socket may be painted white, preferably with the paint used for the sphere, while the exposed part of the lamp-cap may be covered with white cloth or white blotting paper. There still remains, however, the absorption by the bulb, and by the filament and supports. The magnitude of the error thus introduced may be determined for any particular case by the following simple approximate formula:—

Fractional diminution of candle-power reading:—

$$\frac{\text{Surface area of bulb}}{\text{Surface area of sphere}} \times \frac{\text{Absorption factor of bulb}}{\text{Absorption factor of sphere wall.}}$$

A similar formula applies to the filament and its supports, but it will be seen that the loss on this account is generally negligible. Loss in the bulb is, however, quite important in many cases. For clear glass of the thickness used in a lamp bulb the absorption may be neglected. There is a loss of transmission due to reflection at the air-glass surfaces, but this is not a true absorption loss. When a bulb becomes blackened to an extent just noticeable by eye, the loss of light *by absorption* in passing right through the bulb is of the order of 10 per cent. It follows that if such a lamp be measured in a sphere for which the absorption factor is 20 per cent., the error made in the measurement is $\frac{1}{2}(r^2/R^2)$ where r is the radius of the bulb and R that of the sphere. Hence, for the measurement of lamps for which the bulb absorption lies anywhere within the region just imperceptible by inspection, the diameter of the sphere should exceed seven times the diameter of the largest lamp to be measured in it if the error is not to exceed one per cent. If life test lamps, or other lamps showing a greater amount of blackening than this are to be measured, the size of the sphere must be correspondingly increased, the formula given above being taken as a guide to the size required.

(To be continued.)

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* Flux in lumens = M.S.C.P. × 12.57.

† See, for example, N. K. Chaney and E. L. Clark., Illum. Eng. Soc., N.Y., Trans. 10, 1915, p.1. E. B. Rosa and A. H. Taylor, Bureau of Standards, Bulletin, 18, 1922, p.281. (This paper contains an excellent bibliography.)

‡ "Das Kugelphotometer" (Oldenbourg, Berlin, 1920).

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

Developments in Lamps and Lighting Appliances

Some Exhibits at the Opening Meeting of the Illuminating Engineering Society on November 18th.

AT the conclusion of the opening meeting of the Illuminating Engineering Society on November 18th (see pp. 5-9), some interesting types of lighting fittings were exhibited.

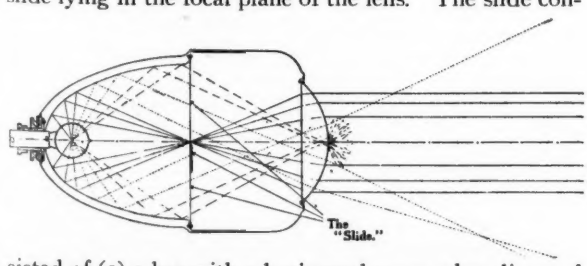
A New Form of Motor Headlight.

MAJOR A. GARRARD remarked that it had long been recognized that improvements in headlamps must take account of two opposing conditions. The driver required adequate illumination, and other road users must not be seriously inconvenienced. It was also accepted that these two results could only be achieved by directing the beams from the headlamps below eye-level. For this purpose it was essential that the upper limit of the beam should be sharply defined—that is, there should be a sudden change from intense light to comparative darkness. It would only appear possible to obtain this sudden "cut-off" by an optical projection system, but the difficulty was that hitherto in securing this condition the intensity of the beam below the cut-off was seriously reduced below that obtainable from an ordinary headlamp.

In the "Moonbeam" headlight, an example of which was demonstrated, the upper limit of the beam was sharply defined, while the intensity of the light below the cut-off was actually greater than was usually obtained from an ordinary headlight giving the same lateral spread, and using an electric lamp of the same candle-power.

Clearly a pair of these lamps, when properly mounted on a car, would give a beam of light flowing, so to speak, along the ground for several feet in front of the car, the upper limit of this light being about waist-high. The driver was thus able to see clearly all objects in front of him up to a height of about 3 ft. 6 in. from the ground, while the eyes of other road-users all were in the dark region above the cut-off, and were thus not dazzled.

The result was obtained, as shown by the diagram, by the combination of two optical systems, each of extreme simplicity. The first was a projecting magic lantern system, consisting of a lens and what was in effect a slide lying in the focal plane of the lens. The slide consisted of (1) a bar with a horizontal upper edge disposed just below the axis of the lamp; (2) an intensely bright spot of light from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. in diameter just above the bar and on the axis; and (3) a surrounding region of considerable lesser intensity.



The lens thus faithfully reproduces ahead of the car the light and darkness conditions of the slide, but inverts them so that the bar below the axis produces the dark region above the cut-off. One side of the lens is formed with a number of vertical grooves which spread the beam out laterally to cover the road, and also serve to give a soft uniform effect free from streaks and patches, but of graded intensity. The second optical system consists of the source of light and the reflector, and its purpose is to collect the light and distribute it as required over the focal plane of the lens. The back part of the reflector is ellipsoidal with the source of light at one focus, and this part collects approximately 70 per cent of the light and directs it through the other focus, which is just above the bar, so as to form the bright spot previously referred to. The remainder of the reflector collects most of the balance and distributes it over the focal plane so as to form the region of lesser intensity surrounding the bright spot.

New Forms of Lighting Fittings.

Examples of recent developments in lighting fittings were shown by representatives of a number of leading firms.

A Street Lighting Lantern.—MR. T. E. RITCHIE (General Electric Co., Ltd.) exhibited the "Wembley" lantern. The high candle-power gas-filled lamp has many advantages for street lighting, but must be used as a lantern of correct type which conforms to the following conditions:—

(1) It must resist water-splash under all conditions of driving rain, drifting snow or mist; (2) the ventilation must be of such an order that, in addition to complying with the above conditions the lamp remains cool, so that its normal life is unimpaired; (3) the light rays must be directed in such a manner that the correct distribution of light is assured, and that the variation in the illumination between adjacent standards does not exceed a reasonable amount. Special efforts were made in the "Wembley" lantern to comply with these conditions. A device, operating on the ejector principle, caused a steady stream of air to be drawn into the lantern and ejected beneath the top cowl. Tests had shown that this system of ventilation safeguarded the lamp from overheating and consequent reduction in life.

The form of unit exhibited by Mr. Ritchie was equipped with a back reflector, and he suggested that it should prove suitable for conditions such as those described by Mr. Cunnington, where illumination of high vertical surfaces, roofs, etc., was important. He mentioned that in the latest form, a maximum candle-power of over 7,000 was obtained with a 1,500 lamp. The modification of distribution of light was effected by means of a special refractor. The position of the filament can be accurately adjusted by means of a simple focusing device. This form of unit has been installed in the Charing Cross district with good results. Recently published curves showed an average illumination of 1.75 foot-candles, a minimum of 0.9 and a maximum of 2.89.

New Reflectors.—MR. MILLNER (British Thomson-Houston Co., Ltd.) stated that with the increase in the illumination furnished for modern lighting installations equipment to counteract the effect of glare was essential.

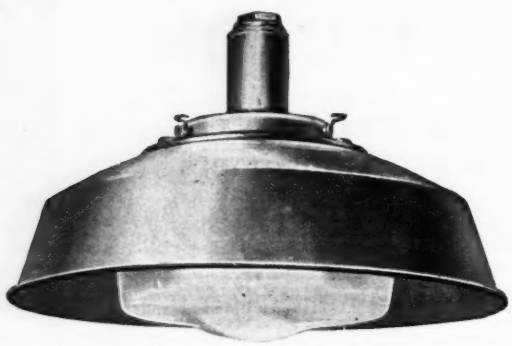
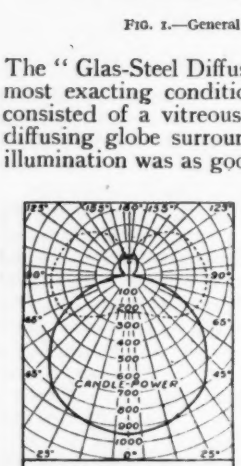


FIG. 1.—General View of "Glas-Steel Diffuser."

The "Glas-Steel Diffuser," which he exhibited, met the most exacting conditions in this respect. The fitting consisted of a vitreous enamel steel reflector, having a diffusing globe surrounding the lamp. The quality of illumination was as good as that obtained from the best totally enclosed diffusing units, and the efficiency for industrial purposes was increased by the use of the over-reflector. The top of the reflector was pierced so that a small proportion of the total light of the unit passed in an upward direction, minimizing the usual dark effect of the upper portion of a direct-lighting installation with opaque reflectors, and reducing the contrast. The contour of the reflector was such that the fitting gave a dispersive distribution, and the globe was designed with steep sides so that dust did not readily accumulate.



ZONE	LUMENS	% TOTAL CLEAR LAMP
0-60	2265	46
0-90	2924	60
90-180	340	7
0-180	3264	67

FIG. 2.—Distribution curve of a 20" "Glas-Steel Diffuser."

The next fitting shown was the "Mirolux Window Trough Reflector." The special construction of this unit gave a high efficiency, coupled with a good angle of "cut-off" in the front. In order to prevent light passing through the glass of the window on to the pavement and to protect the eyes of the public, a series of special spill shields were used, so spaced, and at such an angle that, whilst cutting off the stray light they did not interfere with the reflected light from the unit.

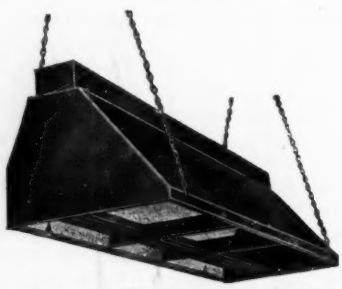


FIG. 3.—"Mirclux Shop Trough Reflector."

Mr. Millner also exhibited a new form of angle reflector designed for illuminating posters and other flat surfaces. This reflector was rectangular in shape, and was particularly suitable for poster lighting, as the "cut-off" at the top was a straight line, and not the unsightly curve obtained with ordinary angle type reflectors.

These three fittings, whilst not showing any radical departure in design, all showed the general tendency towards better and more efficient lighting to meet modern needs.

MR. IVES (Benjamin Electric, Ltd.) then showed a lighting unit of special design embodying the characteristics of a widely distributing reflector, with freedom from glare. This unit, known as the "Biflector," was a distinct advance. The design was based on the correct optical combination of two reflectors, an upper and a lower one. The upper reflector was specially designed to obtain a wide distribution of the light source, and, in addition, to reflect a certain proportion of the light on to the outer surface of the lower reflector, which acts as a diffuser. The lower reflector, cylindrical in shape, entirely shaded the light source from the line of vision. The optical effect of this combination was such that absorption is reduced to a minimum and a highly efficient distribution of the light obtained.

The Biflector had been so designed that various combinations of reflectors may be formed by an ingenious mechanical arrangement allowing easy assembling and adjustment.

Fig. 1 shows an all-metal Biflector, the upper and lower reflectors being constructed of vitreous enamelled steel; all reflecting surfaces being clear white vitreous. The exterior finish is a dark-green vitreous surface. The lower reflector is firmly attached by screwed nickel-plated fixtures to the upper reflector.

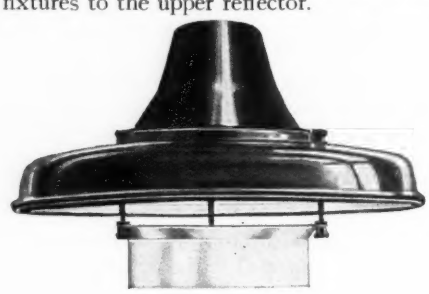


FIG. 1.

In addition to the all-steel type, the Glass Steel Biflector is a particularly useful unit.

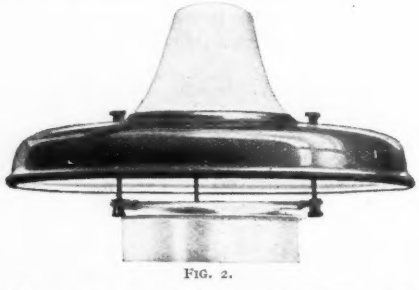


FIG. 2.

Fig. 2 illustrates one of the combinations of glass and steel reflectors. The canopy of the fitting is made of opal glass, whilst the upper reflector is of vitreous steel, and the lower reflector of opal glass. The metal supporting parts, including the lower reflector supporting rings, are nickel-plated. The Biflectors are for use with the ordinary B.C. lampholder, being designed to have a $1\frac{1}{8}$ in. hole at the top of the reflector, and therefore it is a simple matter to fix the units to the existing bayonet-cap shade carrier lampholders.

Biflectors are designed for use with gas-filled lamps, and are so constructed that the filament of the lamp is in correct relation to the optical system of the reflector combination. Bowl enamelled lamps can be used with advantage, although the clear bulb gas-filled lamps give excellent results. In lighting installations where only a low mounting height can be obtained, the Biflector gave very satisfactory results.

Mr. Ives added that there is an endless variety of uses to which these units can be put in industrial, domestic, and public lighting installations. The all-metal type is an ideal unit for industrial work where a fitting of specially robust design is required. Other opportunities for the use of such lighting units occurred in textile mills (such as cotton, silk, wool, spinning and weaving machines, etc.); for the printing industry (compositors' frames, proof reading, engraving, etc.).

The Glass Steel Biflector, apart from its general utility for domestic and public lighting, was pleasing from the æsthetic point of view, and formed an ideal unit for the lighting of libraries, schools, offices, hospital wards, shops and departmental stores.

Colour-Sprayed Lamps.

Mr. L. E. Buckell, in exhibiting a stand equipped with colour-sprayed lamps, recalled that "white" sprayed lamps were shown at the corresponding meeting of the Society last year, and it was then pointed out that the diffusion of light over the entire surface of the bulb was accompanied by only a small absorption of light, estimated not to exceed 6 per cent.

On this occasion examples of lamps were shown to illustrate the progress made in improving the surface of the spray-coating, which was now obtainable in so smooth a form as practically not to retain dust—or, at any rate, so smooth that any dust that did get on could easily be removed by wiping. It was also shown that the colours had been improved both as regards brilliance and even spreading.

Mr. Buckell added that the field for these lamps proved to be even greater than had been anticipated. The coloured lamps were freely used in decorative work, e.g., in signs and outlining; they had also been used to secure special effects in lighting interiors, for which purposes the yellow, orange and flame tint lamps were particularly useful.

A New Form of Illuminated Name Plate for Motor-Cars.

Mr. L. E. Ruthven Murray demonstrated the new "Kayefem" Motor-Car Number Plate, which has been designed specially to meet the requirements of the Police in regard to illumination, and is now in use upon the motor-vehicles attached to Scotland Yard. This number plate is constructed of plate-glass protected by an aluminium frame. The identification marks are etched into the back of the plate glass and illuminated by means of internal reflection in the same manner as that adopted in the "Internalite" signs, examples of which have been demonstrated at previous meetings.

The main difference in regard to the method of illumination is that instead of employing a tubular lamp having a filament nearly equal in length to that of the edge of the plate glass, standard automobile tail lamp is placed at the corner or corners of the glass plate, which is cut off at an angle of 45 deg. The light from this point source spreads practically evenly throughout the glass plate illuminating the marks unusually brilliantly and evenly.

The bulb used for the demonstration was rated at three watts, showing that the brilliance of the illumination was not obtained at the sacrifice of efficiency.

Access to the bulb is obtained by the removal of a screw-on cap holding a ruby glass disc, which forms the tail lamp. A second bulb, which can be fitted in the left-hand corner, can be used to increase the illumination if desired, or may preferably be covered with a cap holding an amber glass disc to form a warning signal, the lamp behind this glass being automatically illuminated by means of a switch connected to the brake pedal. Whilst the risk of breakage of the glass plate is very small, this objection can be overcome by duplicating the identification mark on the black metal background, so that in the event of the glass being broken, the marks are still visible. The identification marks being protected by the glass, the plate is unusually easy to keep clean, whilst the source of illumination, being internal, enables the plate to be read even when splashed with mud.

Hints for the Preservation of Eyesight

It is generally accepted that any defects in lighting, either natural or artificial, which add to the difficulty of "seeing things" are liable to cause deterioration of eyesight. The Eyesight Conservation Council of America has issued a series of hints which should be of special interest to all associated with welfare or safety work, and embody principles which might with advantage be observed in the lighting of the home, schools, offices and factories, etc.

The series of hints is as follows:—

1. The light should shine on the object under gaze, but not in the eyes of the observer.
2. The first remedy is the use of the diffusing glass globes, reflectors, or shades.
3. The contrast of brightness should be within the ratio of 1 to 100. This means the adoption of indirect or semi-indirect lighting in which the brightness of the bowls is reduced.
4. Localized lighting should be used only in conjunction with some general system of lighting, so as to avoid marked contrasts.
5. Avoid the glare of reflection from polished surfaces.
6. Both excessive illumination and inadequate illumination strain and fatigue the eye in order to obtain sharp definition.
7. Intrinsic brilliancy of more than five candle-power per square inch should be reduced by a diffusing medium if the rays enter the eye at an angle below 60 degrees with the horizontal plane.
8. Flickering, unsteady or streaked illumination strains the eye and produces irritation in the eye in its attempt to maintain vision.
9. Special protective glasses should be used to protect the eye from the ultra-violet radiation in excess of that present in daylight as well as infra-red radiation from high temperature molten surfaces.
10. Windows should form as large a percentage of the total wall area as possible.
11. Window shades used indiscriminately are conducive to contrast glare effects. Translucent screens and shades are generally preferable.
12. Ground glass and the like should be avoided in window-sashes which are below the level of the eye, as they cause an increase of brightness in the retinal images thrown on a portion of retina accustomed to such brightness.
13. Dark-coloured finished, walls and ceilings should be avoided if eye comfort is desired, since they are likely to introduce glaring contrasts.

"Sprayed" Lamps for Barbers' Shops

A correspondent draws our attention to one useful application of the lamps with bulbs sprayed with a diffusing coating so as to render the filaments indistinguishable, i.e., in barbers' shops. The problem here is to direct a strong light on the customer's head and face, and overhead lamps in concentrating reflectors are needed. Unluckily a customer who is being shaved, with his head thrown back and gazing upwards, is apt to find the glare from such sources very trying. If, however, the sprayed lamps are substituted for clear ones the effect is much milder and the lamps can be viewed without discomfort. At the same time the diffusion of light over the surface of the bulb gives softer shadows and is probably beneficial in enabling the barber to see his work more easily.

Progress in Gas Lighting

THE last thirty years have seen steady progress in the science of illumination. Both in the domestic and commercial world research and experience have taught us much. The days when interior lighting, both natural and artificial, was left to the builder or to chance are now gone by. The active co-operation of oculists and illuminating engineers in scientific research has already done much to remedy past neglect, and the care of the eyes is to-day fully recognized as an essential and very important item in general health.

Children's eyesight especially needs the greatest attention, for eye trouble is now realized to be not merely a serious evil in itself, but also a considerable contributory cause of many other ills. The first and most important factor in safeguarding eyesight is proper regard for artificial illumination. The light should be correctly placed and shaded. It should be directed upon the work in hand—needlework, reading, music, cookers, and so on—and should never be allowed to strike directly upon the eyes. The light itself must be steady and sufficient; flickering or inadequate light and heavy shadows are especially to be avoided, as they tend to strain the eyes equally as much as does a hard glare. Precautions against all these are as important in the case of adults as in that of children, as essential in the home as in the factory. In the factory it has been established that not only in the interest of the employees' health, but in the employers' own interest, proper scientific lighting is vital.

The gas industry's experts make a special study of the problems and science of illumination in all its branches. Progress is not confined by any means to the theory of the subject. The invention of the incandescent mantle and its subsequent improvement have worked nothing short of a revolution in the practice of illumination. First in its upright, and later in its inverted form, the incandescent mantle has completely changed the method and potentialities of gas lighting.

Not only has the actual source of light been improved, but the design of fittings has undergone a complete change. Beautiful fittings are now to be obtained which will harmonize with any style or period of decoration. Nor is the cost of such fittings necessarily prohibitive. Simple and effective fittings are to be seen in most gas undertakings' showrooms, at all prices. Modern gas fittings are well designed; old-fashioned fittings were often unsightly. It is no economy to retain such out-of-date fittings, as modern burners give much more economical and satisfactory results. An additional convenience, which must be mentioned, is the "distance lighter," which enables the light to be turned on or off, without trouble, from the door or elsewhere in the room.

In calling attention to some of the outstanding features of modern installations of gas lighting, brief reference will be made in these notes to the installations shown in the accompanying photographs.

The importance of good illumination in schools has been emphasized repeatedly by medical authorities. In 1905 *The British Medical Journal*, in an article on "Eyestrain and Brain-strain," referred to researches in various schools in this country, and showed that in the case of nearly half of those visited the lighting was deficient. It is of interest to note, therefore, that the London County Council and many other important educational bodies have since carefully studied this question of the artificial lighting of schools, especially in view of the tremendous growth of continuative education in classes held at night-time. The L.C.C. alone have, as a matter of fact, remodelled over a hundred of their gas-lighting installations in schools during the last few years, with most beneficial results. The gas burners used in all cases were the "super-heater" type, which gives about 50 per cent. more light per cubic foot of gas consumed than the ordinary type of low-pressure incandescent gas burner.

From this it will be seen that the cost of substituting these new burners for obsolete ones will in a comparatively short time be covered by the saving in gas consumption, or, alternatively, where the original installation did not provide a sufficiently good illumination, an increased amount of light will be provided at a cost for gas certainly not higher than the original cost.

In workshops and offices the importance of good illumination cannot be over-emphasized. Official statistics prove that more accidents occur during the dark months than during the summer months, and there are reasons for attributing this increase mainly to defective artificial lighting. It has been estimated that the running costs of an adequate and properly arranged incandescent gas-lighting system are often less than 1 per cent. of the wages bill. If its introduction will ensure a gain in output or quality of work of only 2 per cent. this result alone will more than repay the lighting bill. But this may be the least important consideration when we remember that it means a higher standard of health among the workers. It speaks well for the proverbial long-headedness of Lancashire and Yorkshire manufacturers, and is a good testimony to their thought for their employees' welfare, that in many of their mills they have modernized the gas-lighting installations three times in ten years.

In the office, too, good work depends to no small extent on good lighting. Who would doubt the wisdom of the municipal authorities in Glasgow in providing a gas-lighting system so perfect as that shown in Fig. 2, a system which, by sending the bulk of the light first up to the ceiling and then down, results in a very even illumination and an absence of annoying shadows? An interesting feature of the installation shown in Fig. 3 is the provision of safety gas lamps specially designed for lighting buildings in which there are inflammable petrol or other fumes.

Another type of gas lamp has been specially designed to overcome the difficulty, sometimes experienced in textile mills, of fluff from the materials clogging the air inlets of the burners. These developments are mentioned in order to show how carefully the individual requirements of the different industries are studied and catered for by the gas industry.

Fig. 4 shows a view of part of the interior of the New Street Station, Birmingham, which has recently been thoroughly modernized, and, after full consideration, lighted with the latest types of low-pressure cluster-burner gas lamps, which are controlled from convenient positions on platform level.

An interesting point in connection with Fig. 5 is that the gas lamps shown have been in use for sixteen years, and that the original bodies of the lamps are still in perfectly good condition. Occasional replacement of small parts of the lamps which have worn out have of course been necessary. But the fact that after 16 years' use the lamps are still rendering good service is an indication of the real economy which results from the installation of gas lamps of solid construction and of sound design.

The outside lighting of shops is a matter which should receive much more careful consideration than frequently is given to it. In many cases it will be noticed that powerful unshaded lights are placed right in the line of vision of passers-by, thus causing eye-strain and tending to distract the attention of the potential customers from the goods on show. Messrs. W. H. Smith & Son, the well-known booksellers, librarians, newsagents and stationers, have avoided these defects in the lighting of their station stall, shown in Fig. 6. The gas mantles are screened from the eyes of those passing in front of the stall, and their light is utilized, not to draw attention to themselves, but to emphasize the attractions of the publications exhibited on the stall.

FIG. 1.—The London County Council some time ago carried out experiments in order to discover the best kind of incandescent gas burner which would ensure even distribution of light, adequate illumination, absence of glare and of shadows, and economy in gas consumption. As a result they have already remodelled over a hundred of the gas lighting installations, of which the above is a typical example.

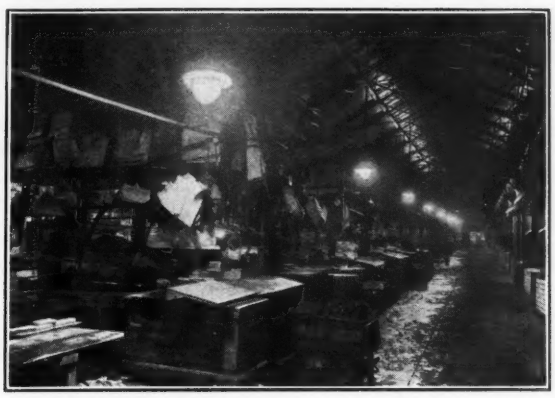


FIG. 5.—Fitzalan Market is the chief shopping centre in Sheffield and is well lighted by thirty-two 3-light low-pressure incandescent gas lamps. The approximate amount of light given by each lamp is 180 candle-power. When the whole of the lamps are alight, the cost per hour for gas is not more than 1s. 3d.

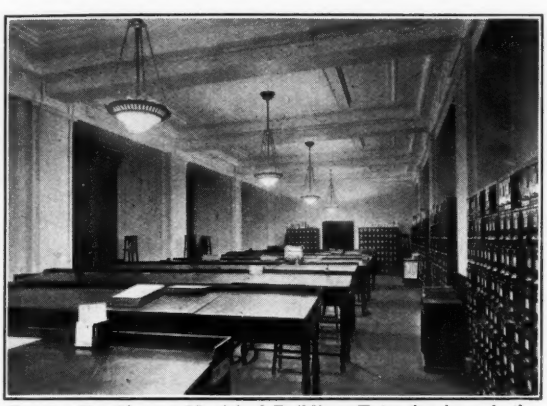


FIG. 2.—The Glasgow Municipal Buildings Extension is perfectly lighted by semi-indirect incandescent gas lighting fittings. The room shown above is the Survey Department. The evenness of the lighting, the almost complete absence of shadow, and the beauty of design of the gas pendants are noticeable features of this installation in one of Glasgow's finest specimens of modern architecture.

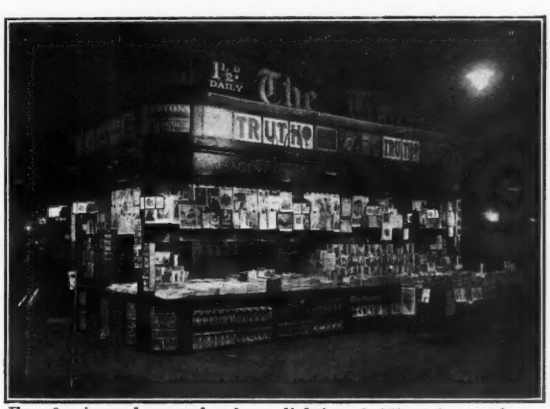


FIG. 6.—A good example of gas lighting—brilliant but without glare. The opal screens fixed to the lamps have a threefold object: to direct the light on to the contents of the bookstall, to screen the source of light from the eyes of passers-by, and to provide an illuminated surface on which the familiar "W.H.S." design can be displayed.

FIG. 3.—A very fine installation of gas lighting in a large London garage. To obviate all risks of igniting petrol fumes, the lamps have been constructed on the principle of the "Davy" safety lamp. The gauzes through which the air passes are easily accessible for cleaning. The burners are so designed that the gas and air are preheated, thus resulting in a high efficiency.

FIG. 7.—The foreshore, all the main streets, and the famous Spa of Scarborough are lighted by incandescent gas lamps employing clusters of four, six or twelve mantles. This installation is undoubtedly a very fine example of what can be done by gas lighting to enhance the attractions of a seaside resort, an example which might well be emulated by other coastal towns.

FIG. 4.—The new lighting of the New Street Station of the London Midland and Scottish Railway at Birmingham was a short time ago placed in the hands of the City of Birmingham Gas Department. A section of the installation is shown above. The low-pressure incandescent gas lamps are fitted with devices by means of which they can be lighted or extinguished from control cocks fixed at paltform level.

FIG. 8.—An official of the Amusements Park of the British Empire Exhibition, with whom the lighting of its two miles of streets was arranged, remarked: "There is one thing in our section that has never given me a minute's anxiety, and that is the gas lighting." This imposing installation was unfailingly in operation every night during the run of the exhibition.

Fig. 7 is a very interesting and beautiful night photograph of the South Foreshore at Scarborough, lighted by powerful gas lamps, some containing as many as twelve mantles. These lamps use gas at ordinary mains pressure, and give very high candle-powers in proportion to the gas consumed, on account of the provision of a super-heater, through which the gas and air mixture passes to the burners in a pre-heated condition.

It has been found that the pre-heating of the gas and air mixture leads to a higher flame-temperature, and this higher flame-temperature in turn results in increased mantle luminosity, an advantage which is further enhanced by the fact that the whole area of each small mantle is brought to a state of full incandescence. Another notable installation of gas lamps for street lighting is that shown in Fig. 8. It is part of the two miles of streets in the Amusement Park at the British Empire Exhibition, where 96 per cent. of the visitors were found to congregate after dusk. The lamps used were placed on specially high standards, in order that their outstanding brilliance might attract visitors to that section of the grounds, where at night-time brightness and boisterous fun could be found.

These illustrations are sufficient to demonstrate the high state of perfection to which gas lighting has been raised within the last few years. A final point to be borne in mind, however, is that to obtain the best possible results, satisfactory conditions of maintenance are necessary. Periodical inspection and thorough cleaning and adjustment of the burners are essential if the best and most economical results are to be obtained. Many gas undertakings are prepared to render this service regularly for a small inclusive charge—a charge more than covered by the resulting improved efficiency of the appliance.

Smoke Pollution and Ultra-Violet Light

The great loss of visible sunlight through the pollution of city atmospheres by smoke is well recognized. The presence of smoke particles in the atmosphere converts what would otherwise be a white fog into a "black" one; and even on a clear day it greatly diminishes the power of the sun's rays. It is important to note that the obscuration is greatest in the case of rays of short wavelength (with the result that the sun, seen through a veil of smoke, appears *red*) and probably greatest of all in the case of the invisible ultra-violet rays.

Now recent medical researches have established the fact that the beneficial effects of sunlight are largely associated with the presence of a moderate proportion of ultra-violet rays. Certain "diseases of darkness" are believed to be fostered by their absence. Doubtless a dark foggy winter such as we have experienced is prejudicial both to the health and spirits, and its effects are intensified in the smoke-laden atmospheres of large cities.

Dr. F. W. Alexander, in a special report to the Poplar Health Committee,* recently quoted from Dr. Percy Hall's book on "Ultra-Violet Rays in the Treatment and Cure of Disease." The non-consumption of smoke not only wastes energy, causing loss of money, but pollutes the air, ". . . . the smoke-laden air over our towns and cities almost entirely rids the ultra-violet rays which succeed in reaching us of their healing properties. This smoke problem is of vast and far-reaching importance in this respect alone, quite apart from its being the cause of a great deal of respiratory disease, owing to the irritating effect of inhaled particles."

Dr. Alexander describes the beneficial effects of light treatment on anæmia and rickets, as applied at a number of hospitals. Treatment in the form of exposure to a special long-flame arc is given three times a week, the eyes of children and attendants being protected by special goggles. Six weeks' treatment has resulted in general improvement in health of children, who sleep and eat better and are less subject to irritability.

Thus the ultra-violet rays, recognized as a possible source of injury to the eyes unless adequate protection from excess is provided, are also being found beneficial to health, if used with discretion, and should not be regarded by illuminating engineers as an unmixed evil.

Some interesting records of intensity, of ultra-violet light, obtained simultaneously at observation stations in the Strand, Hampstead, Greenwich, and Peppard (Oxon.), have recently been published by the National Institute for Medical Research. The intensity of the rays is measured by the bleaching of a standard solution of acetone and methylene blue, and the steps in the scale of colour correspond to well-marked biological action.

The results reveal the very low intensity of ultra-violet light at the London stations during December; at Kingsway the reading was practically nil, but was appreciably higher at stations in the country. The great difference between winter and summer sunlight is also revealed. In September values averaging about "3" were recorded at Hampstead, and about "2" in the Strand, while at Lowestoft intensities ranged from about "4" to "7." On the other hand, during July, an index figure as high as "18" has been registered at Hampstead, and at Peppard as much as "24." Very much higher intensities have been recorded abroad, for instance at Leysin, Switzerland, in the month of August the value ran up to "41."

There is little doubt that the very low values recorded in London during September and December are due largely to the obscuring effect of smoke.

* *The Medical Officer*, December 13, 1924.

Music and Light.

In view of the suggestions on the relation between Light and Music, made by Miss Mary Wurm at the meeting of the Illuminating Engineering Society on December 18, 1924, it is interesting to have in an evening paper a letter on this subject by MISS EVA DIGBY O'NEILL, of the Æolian Hall Studios. The possibilities of special lighting effects as an adjunct to Scriabine's "Poems of Fire or Ecstasy" are discussed. Miss O'Neill also emphasizes the importance of subdued lighting in aiding concentration of attention on music. She suggests that the average hall is far too brightly lighted, and that, the eye being able to wander and observe objects around it, the ear cannot so completely fulfil its function of listening to the sound.

Thus, even in the concert hall, the methods of lighting now being adopted in kinema studios may be found useful. Lights might be gradually diminished during the actual performance (without it being necessary to descend to the degree of darkening desirable when viewing a film), and in certain cases lighting effects which supplement the impressions conveyed by the music might be contrived—just as, in the modern kinema, special illumination is now often provided in accord with the action shown on the screen.

Scientific Shop-Window Lighting

SHOP-window lighting is showing a marked improvement both in London and the Provinces, and it is very evident that shopkeepers are rapidly appreciating the value of well-designed and attractive lighting arrangements.

Our illustrations show a typically well-lighted tailor's window in London. The installation, which was designed by the Illuminating Engineering Department of Siemens and English Electric Lamp Co., Ltd., consists of Siemens's Daylight (or colour-matching) gas-filled lamps, in mirror glass trough reflectors. Three spotlights are also installed, which serve to focus attention on special lines by making them stand out conspicuously from the remainder of the goods in the window.

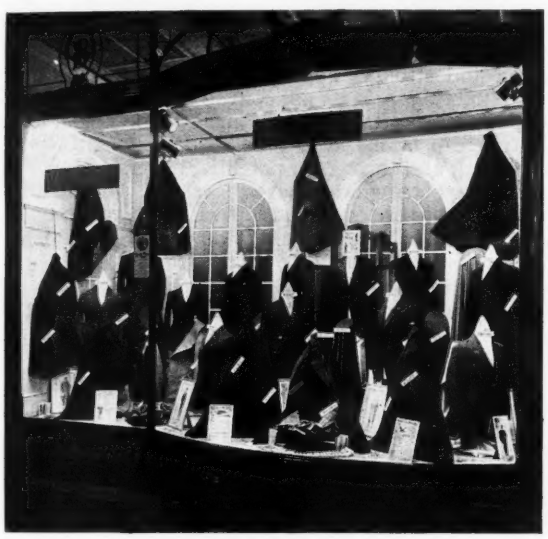


FIG. 1. Showing General Effect.

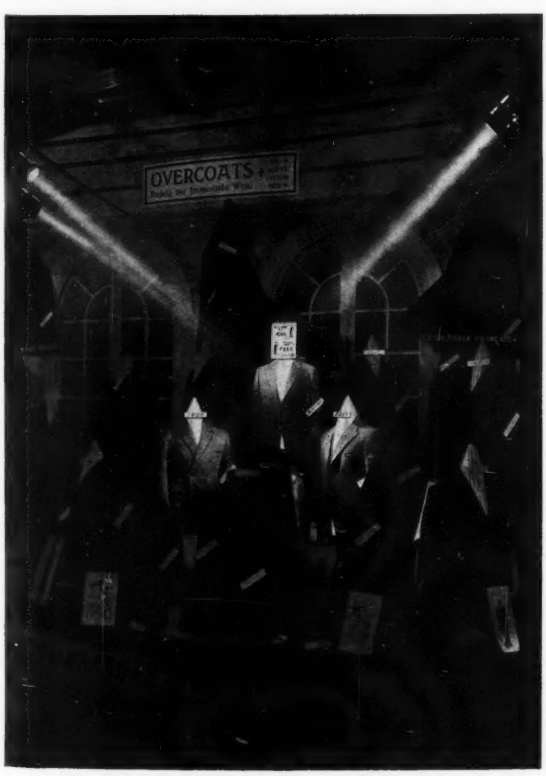


FIG. 2. Showing Special "Spotlights."

The general result is a good quality of evenly distributed light of high intensity, which gives the window a distinctive appearance and does not fail to arrest the attention of the passer-by; further, by virtue of the colour-matching lamps, the would-be purchaser is able to easily distinguish the various shades of colour in the materials and cloths on view.

The value of a show window as a silent salesman can be greatly enhanced by leaving the spotlights on after closing time, as illustrated, controlled by a time-switch set to automatically switch off at any given time.

Those shopkeepers in the textile trades who have not tried the use of these special lamps for colour-matching purposes would be well advised to give them a trial both in the window and inside the shop.

Some Notes on Electric Lamps

No. 1

By W. J. JONES, A.M.I.E.E.

(E.L.M.A. Lighting Service Bureau).

THE BOWL-SPRAYED GAS-FILLED LAMP.

IN the early days of the tungsten filament lamp it was common to have the filament partially obscured either by sand-blasting or acid etching, but with the advent of the gas-filled lamp there are many installations which are rendered inefficient because of the exposure of the bare filament, and this is particularly objectionable in the case of industrial lighting systems.

During the past few years dispersive reflectors have been designed which give a definite angle of cut-off in an endeavour to reduce the amount of glare which is apparent. This, however, is not quite sufficient, for, although it eliminates glare to a worker some little distance away from the unit itself, the operative in the proximity of the unit still experiences eye-strain and discomfort. In order to meet this difficulty the bowl-sprayed lamp has been introduced, and it will be found that it differs from the bowl-frosted lamp inasmuch that the surface is definitely white, and may be described as having an eggshell finish. When lighted the lamp can be viewed end-on without discomfort. The material is superficially applied, and is extremely durable, and it is capable of resisting almost any mechanical abrasion. It will not chip off, and repeated tests have shown it to be proof against deterioration by acid fumes.

Fig. 1 shows the bowl-sprayed gas-filled lamp, and Fig. 2 illustrates the distribution curve which is obtained. It will be seen that a large proportion of the light is projected upward.

FIG 1.

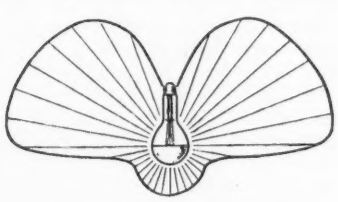


FIG 2.

When used with a dispersive reflector it will be appreciated that the light is reflected from the interior of the sprayed bowl of the lamp on to the interior of the reflector, and is then distributed in order to give a maximum effect just where the illumination is required.

Decorative and Artistic Electric Illumination

IN modern times artificial lighting has always been associated with efforts of decoration, and quite recently manufacturers of electric lamps have introduced new types of lamps which contribute immensely in this direction. Quite often the lighting of exhibits and displays was accompanied with considerable glare, which in a large measure detracted from the merit of the lighting provided, and also impaired the display itself. The question of glare has been still more accentuated since the introduction of the gas-filled lamp, for so often its use has been abused, and it is often installed minus either adequate reflectors or light-diffusing equipment.

The lighting of the Albert Hall for the N.A.R.M. Wireless Exhibition, 1924, is indicative of the progress which has been made, utilizing the new lamps that are now at our disposal. Ordinarily the building is lighted exclusively from the dome by means of a number of powerful units, but the appearance generally can hardly be called entrancing. For the occasion of the Wireless Exhibition an endeavour was made to give the hall a festive appearance, and yet to retain a great deal of its usual dignity and grandeur.

In order to eliminate any possibility of glare opal-bulbed and white-sprayed gas-filled lamps were used throughout. Fig. 1 shows the scheme which was adopted. A three-tier corona was suspended high up in the building, from which seven strips radiated and drooped in graceful lines towards the second tier of boxes. These strips or swags each consisted of eighty 60-watt gas-filled lamps, which could be switched on in sections. The main three-tier corona was constructed as follows:—

Top Tier—
15 ft. diameter, supporting 90 100-watt gas-filled lamps
Middle Tier—
13 ft. diameter ,, 78 60 ,, ,, ,,
Bottom Tier—
11 ft. diameter ,, 66 60 ,, ,, ,,

The lighting was further supplemented by means of eight smaller corona fittings, and also by the lamps surrounding the central kiosk. Each of the eight fittings had two tiers of lamps, and the dimensions and number of lamps are as follows:—

Upper Tier—
8 ft. diameter, lighted with 18 100-watt gas-filled lamps
Lower Tier—
6 ft. diameter, ,, ,, 36 60 ,, ,, ,,

All told, 1,700 lamps were used, and the current consumption was over 600 amperes. The resultant illumination on the floor level was 18 foot-candles, and the effect pleasing and in every way satisfactory. Although this high intensity of illumination was obtained there was a complete absence of glare.

Colour Lighting.

Yet another important contribution to decorative illumination is the advent of the colour-sprayed lamp. These lamps are made in many colours, and can be used effectively to enhance the lighting in various ways. Coloured lighting makes everything more attractive, and the modern method of applying the coloured material makes it of much greater practical importance. It is now possible to obtain lamps which give a considerable amount of coloured light, and at the same time will prove permanent in operation. The colour medium is sprayed on to the bulb of the lamp, and is so fast that it will readily withstand great heat and the inclemency of weather out of doors. As a test of operation under difficult conditions a number of lamps were boiled in brine for two hours and proved entirely satisfactory, and as a result of this test the lamps are finding much favour in the decorative lighting of seaside resorts.

Perhaps a more artistic use of coloured lamps is to be found in the lighting of shop windows. It is well known that high intensity of illumination makes a window attractive, but the introduction of colour makes the window still more attractive, producing an added

F.G. 1.—Showing Lighting Scheme at the Albert Hall.

charm and stronger appeal to the senses. It is a pity that photography does not convey any indication of the beautiful effects that are obtained. The colour of the lighting can be made to tone with the fabric which is displayed, and throngs of potential buyers will be found examining such windows every evening. The coloured sprayed lamps are often placed 6 in. apart, and the use of amber-coloured light is suggestive of bright and warm sunshine, and is strikingly effective in its application.

It is anticipated that within the next few months there will be many such well-lighted shop windows that will persuade throngs of people to inspect shops, even when they are closed, because of their intrinsic beauty.

A still further field for the use of these lamps is for the lighting of large electric signs, and it is hoped at a later date, to give some information regarding them.

Illumination Design Data

Some Useful Information for Contractors

THE Lighting Service Bureau of the Electric Lamp Manufacturers' Association have just published, under this title, Handbook No. 2 of their series of Electric Illumination Bulletins. In this handbook we find, conveniently tabulated and succinctly explained, all the data necessary for the correct and rapid lay-out and calculation of an artificial system of illumination for practically any kind of commercial or industrial interior.

The contents offer every facility to the contractor, architect or consulting engineer, to avail himself of an empirical method of providing appropriate illumination based on present standards; those who, in the past, fought shy of the science of illumination on account of the time and supposed intelligence required to assimilate its principles owing to the way they were presented, have now no such excuse. Every factor that could possibly be thought of is provided for, and—given the dimensions of the interior, the operations to be carried on and the colour of the decorations—everything else follows from reference to the tables and some elementary calculations involving only a few minutes' work.

The data are based on present-day standards of illumination with modern lighting units and gas-filled lamps. After defining, in simple language, the lumen, foot-candle, coefficient of utilization and depreciation factor (merely for the sake of convenience, as these terms are employed), the handbook sets out the steps in the design of a lighting system. The first thing to do is to decide the foot-candle illumination required; this is obtained from a table occupying eight pages, in which every conceivable interior is listed with the corresponding recommended illumination. The next step is to decide on the lighting unit (or fitting); two tables of these, showing sketches, comparative charts and ratings based on seven fundamentals, permit of selecting the best unit for the purpose in view (with the application of a small

amount of arbitrariness and intelligence). This done, additional tables indicate at once the permissible spacing of the units in relation to the floor plan and the mounting height. The size of lamp is then arrived at by a simple calculation and with the aid of further tables. Finally, the actual illumination in foot-candles is derived from a table of computed illumination values, which serves as an approximate check on the whole of the foregoing process.

In order to assist the reader, concrete cases are given by way of example, and the designs for these are worked out in detail. The extreme simplicity of the method is at once apparent; and the user of the handbook, if previously unversed even in the elements of the science, will at once appreciate the significance and utility of the facts and will understand how to apply them.

Two pages deal with reflection factors of coloured surfaces—specimens of colours being shown, with the corresponding percentages of light from gas-filled lamps, which is reflected from them. This information should be of great value to architects, because the illumination of an interior is frequently poor through failure to understand how much light is absorbed by colours. The reflection factors given enable the calculator to determine the coefficient of utilization in the table provided for this purpose—one of the sub-steps in the method already referred to.

It is to be hoped that the distribution of this useful little work will bring about a more general application of the principles involved, as well as an appreciation of the fact that an appropriate standard of illumination conduces to physical and mental well-being, and therefore to more efficient activities in all the walks of life.

The Motor-Car Headlight: its Possibilities and Limitations

The search for an "anti-dazzle" headlight has had at least one good result. It has led to a better understanding of what headlights can do. A beam, however powerful, has limitations—especially those imposed by the objects illuminated. The very dark surface of tarred roads is a drawback. The contrast between a person in dark clothes and this background is but small, and the illumination necessary to reveal such objects is correspondingly high.

In planning the roads of the future all factors, lighting as well as nature of surface, should be considered. Surfaces of concrete have been the subject of experiment. A concrete surface, being so much lighter, might enable a less powerful beam to be used.

Another point to be realized is that a headlight, even a good one, furnishes a "glancing" illumination, i.e., it illuminates the road at an extremely oblique angle. Such uni-directional lighting is not really well suited to the illumination of most objects. They lack perspective. Small irregularities in the road are magnified, which is possibly advantageous; but in some instances the shadow is deceiving.

One special instance of the effect of this glancing beam is afforded by the appearance of puddles of water. The beam is naturally reflected by the surface of water ahead, possibly dazzling approaching persons; and to the driver himself the water does not show up at all. During the floods of December inability to locate fairly deep water ahead has often proved embarrassing.

This little point serves to show that headlights cannot do everything. Public lighting by distributed lamps is extremely valuable to the motorist and it is to the better lighting of our roads that we must look for the real solution of the headlight problem.

Shadows by Natural and Artificial Light

The two illustrations accompanying this note appeared in *The Illuminating Engineer* many years ago, and also in *Modern Illuminants and Illuminating Engineering*. They will probably be new to many, if not most of our present readers, and illustrate in a most striking way how contrasts and shadows differ by natural and artificial light.

The two photographs were taken from the same viewpoint, but whilst one was taken by daylight, the other was photographed at night, solely by the light furnished from the fittings mounted on the ceiling. It will be agreed that both make charming pictures—possibly the one by artificial light might be considered the more pleasing of the two.

FIG. 1.—A View of the Office of a Shipping Company by Daylight.

Yet in Fig. 2, the conditions of shadow as revealed in Fig. 1 are almost completely reversed. The pillars now stand out against a light background, the dark spots on much of the ornamentation become light spots, and vice versa; the brightest object is now the luminous bowl on the ceiling, which by daylight is relatively dark; the lines down the pillars are also different.

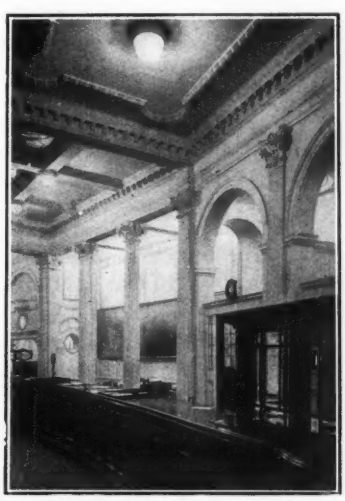


FIG. 2.—The same View taken by Artificial Light.

The pictures are useful in showing how the design of the architect is affected by artificial lighting. The effect may be worse (or it may possibly be better), but the result depends very much on the consideration paid by the architect to the scheme of artificial lighting to be employed.

London's Future Traffic and Lighting Problems—A Vision

By A Correspondent

The close relation between street lighting and traffic is now generally admitted. The congestion of the streets calls for special measures to deal with the vast volume of motor traffic; and the provision of ample lighting in the streets is an essential to safe driving and rapid motion.

Some architects, looking far ahead, have predicted highly novel methods of meeting the traffic problem. Already we have proposals for new underground tunnels; another tunnel under the Thames is being considered, and a subway under the parks has even been proposed. But in the future London may possibly have recourse to overhead routes. We might not only have elevated railways, but wide parapets for pedestrians, running along the face of buildings, and linked by bridges crossing the street. Those who have visualized these possibilities have suggested buildings rising in stages, each stage being set back a little, so that the building becomes narrower as one reaches the top. This would, in a measure, help to ameliorate one obvious drawback of overhead traffic—the obstruction of light.

Some have also drawn attention to another possibility, the growth of a vast aerial traffic. Besides dealing with vehicles in their streets, cities of the future may have to provide for considerable traffic in the air, which has led to the suggestion that large flat areas might be erected across the roofs of buildings, serving for aircraft to alight or depart. Passengers would thus leave the aeroplane at an appropriate centre, descend a stage further to an overhead railway, or further still to the "walking parapets," or ultimately below the ground to the tube system.

A city constructed on these lines would have a degree of "solidity" difficult to imagine. It would tend to become one vast building, the ventilation of which would present serious problems. Long before this age was reached the abolition of present uneconomical methods of burning coal would doubtless have gone far to relieve the fog problem. But a honeycombed city of this kind would require constant fresh currents of air and artificial ventilation on a large scale might be necessary.

The most important consequence of these overhead structures would, however, be the obstruction of light, True Londoners might have the advantage of rapid conveyance to "roof-roads," where there would be complete access of light; and the roofs of buildings might be utilized as they already are in the East. But the lighting of the lower stages, the business and dwelling areas, would be a serious consideration. It would be necessary to supplement such natural light as filtered down to these regions by artificial light on a large scale.

Even to-day, in congested city areas, it has been debated whether the costly provision of light-wells and similar devices to admit daylight are worth while. In such a city as has been pictured above, adequate access of daylight would at many points be impossible. Mingling of artificial light and daylight is not usually satisfactory. But by the time such changes have arrived our illuminating engineers would doubtless be ready with an economical illuminant identical with daylight not only in colour, but also in the presence of ultra-violet light to the same degree as is found in the light from the sun. Thus ultimately dwellers in a city, even in the most congested centres, would enjoy true "artificial sunlight," a perpetual summer so far as light is concerned.

Lays on Illumination

I.—GEORGE ADOLPHUS GREEN.

WHEN George Adolphus Green was born
  The fairies were unkind to him;
He entered on a fate forlorn
  Because the light was far too dim.

In narrow city streets he played,
  In smoke and grime his work was done
(No Smoke Abatement League inveighed
  Against the darkening of the Sun).

Adolphus had a poor physique,
  A consequence of Lack of Light;
His legs were queer, his sight was weak,
  He could not get his sleep at night.

His parents, used to leaden skies,
  Did not consider "How?" and "Why?"
They said "Poor George's legs and eyes
  Will perhaps get better by-and-bye."

So George was soon dispatched to school;
  He did not find the work a joy.
They said, "The lad's a perfect fool—
  A very inattentive boy!"

To George's inefficient eyes
  The blackboard figures were obscure
(The lighting, we must realize,
  Was quite exceptionally poor).

No wonder that his sight grew worse,
  His knowledge was a smattering,
His errors sometimes earned a curse,
  And sometimes brought a battering.

His education quite "complete,"
  Adolphus entered industry,
And learned how very obsolete
  Industrial lighting's apt to be.

Sometimes he worked for love of gain,
  And sometimes "went upon the dole,"
Which he was able to obtain
  With little trouble on the whole.

At last a little oversight—
  (Rotating flywheels were concerned);
A glaring source is bad at night,
  As Georgie very quickly learned.

The Coroner, the verdict given,
  Alluded to his want of care,
Not knowing (may he be forgiven)
  The shocking lighting everywhere.

This is the melancholy tale
  As given by a near relation,
Showing how Georgie came to fail
  Through want of *Good Illumination*.

MORAL.

If George's teachers had perceived
  The cause of their dissatisfaction;
If George's eyes had but received
  Glasses correcting wrong refraction;
If school and factory, up to date,
  Had had good lighting everywhere,
How very different George's fate!—
  He might have died a millionaire!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LAMPS
MAZDA
GASFILLED
MAZDA
B.T-H PATENT
Assurance
WHEN you buy a Mazda Lamp, you have the satisfaction of knowing that there is no better lamp available, and that in no other way could you get the same amount of light at lower cost.
The cost of the lamp itself is a small item in the total cost of lighting. It doesn't pay to save pence on lamps and lose shillings in current. A Mazda Gasfilled Lamp will give you as much light as can possibly be produced for a certain expenditure on current and lamps. No lamp can give you more; many lamps will give you less. Take care your lamps are Mazdas, and your light will take care of itself.
Ask for Mazda Lamps by name.
All Electricians, Ironmongers & Stores stock them.
Advertisement of The British Thomson-Houston Co., Ltd.
B
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TRADE NOTES & ANNOUNCEMENTS

A NOVEL ELECTRIC SIGN AT MANCHESTER.

An exceptionally large sign of novel form has been erected over the emporium of Messrs. Lewis's at Manchester. This sign, which depicts children dancing round a Christmas tree, contains more than 3,000 Osram clear and colour-sprayed lamps. The illustration gives a good idea of its general appearance and appropriate Christmas design. We understand that for signs of this nature the colour-sprayed lamps are proving very attractive.

STREET LIGHTING FITTINGS FOR GAS-FILLED LAMPS.

Much attention is being devoted to the design of lanterns for high candle-power gas-filled lamps used for public lighting. An improved form recently introduced by the Photector Co., Ltd. (Palmer Street, Westminster) deserves notice. This is provided with the customary refractor inner globe to improve the distribution of light and promote uniformity of illumination. It has also a further special feature—the use of a supplementary refractor to be adopted when gas-filled lamps with the ring filament are used instead of those of the "zig-zag" type. This alteration in the form of the filament would ordinarily make a considerable difference to the light distribution. It has also the effect of rendering the surface of the globe unevenly bright. The accessory referred to above is stated to correct these effects quite satisfactorily.

The same firm is also showing forms of "bell-shaped" glassware, which have proved very popular on the Continent. This form of fitting can be designed in various ways. It may be composed entirely of opal glass, in which case it provides general distribution of light; or by making the upper portion of lightly-etched glass, diffusing white glass being still retained for the lower bowl, one gets what is essentially a totally enclosed, semi-indirect unit.

PROGRESS IN GAS FITTING DESIGN.

It is a matter of general agreement that there has been great progress in the design of gas fittings during the last few years. The choice before the consumer to-day is far more varied than in the past. Semi-indirect lighting can be achieved with gas lighting as well as with electric lamps; many new and pleasing forms of units utilising vitreosil and other diffusing glassware are now available.

Whilst, as in all industries, there are some firms that tend to cling to old methods, there is general evidence of progressive methods, in which some of the younger firms are taking a prominent part. During a visit to Messrs. H. Staniorth and Co. we were interested to see several units in which the principle of enclosing a cluster of mantles with a surrounding reflector, so that the mantles are completely concealed from view at eye-level, is happily adopted. Even to-day unduly shallow forms of reflectors are apt to be too commonly used. With the source well inside the reflector the concentration of light readily gives illuminations quite as high as are needed for any ordinary industrial process. Such units can also be applied to special uses not usually associated with gas lighting, for instance, "flood-lighting," provided the angle of dispersion required is not too confined. There is no reason why much of the illumination of large hoardings, etc., should not be done with gas.

Messrs. H. Staniorth and Co., it will be recalled, were largely responsible for the supply of apparatus for the lighting of the Amusement Park at Wembley, and are well equipped for standard lines of work. At the same time they are open to design special fittings for particular purposes, and have exceptional resources for the spinning of metal for novel shapes of reflectors, etc.

ZEISS REFLECTOR LAMPS.

An interesting new lighting unit now being introduced by J. W. Atha and Co. (8, Southampton Row, London), appears to have distinct merits where concentration of light downwards in offices, factories and shop windows, etc., is required. These units are the product of the famous firm of Zeiss. The chief characteristic is the use of an upper parabolic metal mirror of special design. Below this is a bowl of diffusing glass which serves to soften and diffuse the light, without scattering it too widely, is commonly used. The fitting can be mounted direct on the ceiling and terminated in a flanged metal cylinder enclosing the neck of the gas-filled lamp. A feature in some forms is the use of a swivel-joint so that the unit can be turned in various directions; this is likely to be of considerable service for show-window lighting.

If necessary the unit can also be provided attached to a vertical metal arm and swivelled at the lower end for industrial use.

WELSBACH BURNERS.

A short time ago we referred in these columns to the series of inverted incandescent burners now offered by the Welsbach Light Co., Ltd., mentioning particularly those of the "Eddystone," "Tuskar," and similar types. The "Calshot" type is another one which is expected to become very popular. Besides being solidly made it is fitted with a flat type globe carrier with two wings to direct products of combustion and prevent discolouration and the special locking screwed air regulator enables an exceptionally fine air adjustment to be effected and maintained. This burner can be supplied with pepper box or open nozzle if desired. It is also supplied as a cluster burner fitted with iron super-heated chamber for three Bijou size mantles.

STREET LIGHTING IN AMERICA.

From the Westinghouse Electric & Manufacturing Company (East Pittsburgh) we receive advance proofs of a forthcoming publication entitled, "The Engineering Achievement of the Westinghouse Company during 1924."

Of special interest is the section dealing with street lighting. Some attractive forms of ornamental lanterns are shown, and attention is drawn to the general tendency towards higher mounting heights. An unusual type is the "Highway Lighting Unit," which utilizes a parabolic mirror and a double set of refracting prims, designed to furnish a beam in two directions along the length of the street. The unit is mounted on a bracket arm with jointed attachment so that the inclination from the vertical can be adjusted according to the nature of the street to be lighted.

ARTIFICIAL DAYLIGHT.

Efforts have been made for some years now to reproduce daylight from artificial media as so many industrial operations, especially those where colour matching is important, cannot otherwise be satisfactorily carried on during the winter months except for a few hours per day. Attention may be directed in this connection to the Lamplough Daylamp, which is now recognized in a large number of industries to have achieved extremely satisfactory results. It is claimed that the opinion of the leading textile concerns in this country is practically undivided in favour of this lamp.

The Lamplough Daylamp is a high-precision artificial daylight lamp which makes use of a special double glass screen, the invention of Mr. F. E. Lamplough, the well-known authority on the manufacture of scientifically coloured glass. In order to obtain greater accuracy than was previously achieved it was found necessary to use certain ingredients in the screen which are not conveniently worked together in one glass base. Hence the Lamplough Daylight screen consists of two separate glasses. The special ingredients contained in this screen give it peculiar physical properties and enable it to achieve great accuracy in the reproduction of average daylight.

ACETYLENE AND OTHER SPECIALITIES.

A series of publications issued by Messrs. Allen-Liversedge, Ltd., which are now before us, cover practically all aspects of acetylene lighting. Two editions of the Fittings Catalogue (Cb. 19 and Cd. 19) are got up in quite distinct styles. The first of these (Cb. 19) is executed entirely on mat paper of good quality and contains line sketches of fittings; Cd. 19, on the other hand, contains half tones, a feature being the imitation candles, for which the acetylene flame is specially well adapted.

In the lists devoted to Lighting Installations we find again two styles of treatment. Besides particulars of plant there are in the one case photographs of a large number of country mansions in which acetylene is used. In the other case ("Lighting Installations in Town and Country"), the get-up is distinctly original, the paper being of superfine quality, while the illustrations consist of pleasing pen-sketches showing the appearance by night of lighted bungalows, country mansions, municipal buildings, bungalows, cowsheds, etc. Another interesting feature of this catalogue is that it refers to country lighting installations by acetylene, petrol air gas and electricity, as the firm is prepared to install any of these systems.

Amongst other publications may be mentioned the comprehensive list dealing with all uses of Dissolved Acetylene, the descriptions of portable lamps, storm-proof lights and flare lamps, and welding and cutting apparatus. Altogether the series aptly illustrates the varied applications of acetylene to-day.

ILLUMINATING ENGINEERING AT WEST HAM.

The West Ham Corporation Electricity Supply Department has for some time been regarded as one of the most progressive undertakings of this nature. It has potential capacity for considerably greater load, and accordingly has every inducement to impress on consumers the benefits of better illumination. A feature is the showroom in the Romford Road. The contents of the window display are changed constantly, and during a recent visit we were interested to see a large panorama, depicting mountain scenery, which formed part of the Christmas week special show. The picture was illuminated by overhead "daylight" lamps with a view to showing off the colours to the best advantage. West Ham is of course a highly industrial district, and presents many opportunities for urging the advantages of good lighting in factories and workshops.

A NEW GAME.

THE "WIZARD ELECTRIC"—A FREE OFFER.

A free offer is made to *Electric Light Users* by Messrs. SIEMENS AND ENGLISH ELECTRIC LAMP COMPANY, LIMITED, 38/39, Upper Thames Street, London, E.C.4.

This Company has brought out a new game called the "Wizard Electric," and offer to send one to any reader who applies to Publicity Department at the above address, enclosing a 2d. stamp for postage, and mentioning this paper. It is played somewhat on the lines of "Snakes and Ladders" and similar games.

It has been prepared in colours on chromo board with appropriate illustrations of the stages of the game. The board is divided up into a numbered course and the game is played with a dice. It is really a very interesting game and would while away many a long hour in the winter evenings.

PHOTOGRAPHS BY ARTIFICIAL LIGHT.

A feature of much recent catalogue literature on illumination is the inclusion of illustrations of striking lighting installations. For this purpose photographs, ***taken entirely by the light from the units actually employed in the installation,*** are probably best, though there is an opening for good sketches as well. Photographs of this kind, however, have a special value as evidence. They show the actual conditions of lighting obtained, and are much more attractive than any view of a fitting in impressing the consumer. Preferably such photographs should be untouched. In the case of a good installation, with lights properly screened, one can usually avoid retouching; but if there are brilliant exposed lights halation, almost masking the fittings, is extremely difficult to avoid.

Some recent Benjamin publications contain excellent photographs of factories, illuminated signs, show-windows, etc. The well-known view of the outside of the Army and Navy Stores, showing the flood-lighting effect, is also an admirable photograph. Occasionally the high intensity of the illumination enables the exposure to be short enough for figures of people to be included—as, for example, in the account published by Messrs. Siemens and English Electric, Ltd., of the artificial lighting of a football ground some time ago. In a factory it is sometimes possible to arrange for workers to stand at their work long enough to be photographed. Instantaneous photography by artificial light is at present usually impracticable, though something very near it has been attained in photographs of the stage, where the illumination is exceptionally high.

THE ELECTRIC ILLUMINATION BULLETIN.

The December (No. 2) issue of this bulletin, issued by the E.L.M.A. Lighting Service Bureau (15, Savoy Street, W.C.2.), contains some useful data. We notice that in the tables of foot-candles a distinction is drawn between values recommended and the range possible under some conditions; also that a note at the foot of the tables reminds readers that glare must be avoided. A useful feature is the inclusion of samples of coloured papers, with the approximate reflection-factor assigned to each. There are also some comprehensive tables presenting "coefficients of utilization" for various types of lighting units and different conditions as regards colouring of walls and ceiling.

THE BRUSTON SYSTEM OF REFRIGERATION AND ICEMAKING.

Whilst this journal is primarily concerned with lighting, readers may be interested in the ingenious "Bruston" refrigerating machine. This is supplied by Messrs. G. C. Pillinger & Co., sales and service agents to R. A. Lister & Co., Ltd., whose name is connected with the manufacture of automatic lighting plant. The refrigerating machine described appeared to be entirely automatic. One merely turns on a switch to start the apparatus, and the machine reduces a brine solution to a temperature well below freezing point. The machine requires no ice nor special chemicals. The smallest size is capable of making 250 c. ft. of ice per hour, and the cost of electric energy used is stated to be only ¾d. per hour for this model.

CONTRACTS CLOSED.

We are informed by Messrs. Siemens and English Electric Lamp Co., Ltd., that they have received acceptance of the following tenders :—

London Midland & Scottish Railway.—Large quantity of SIEMENS Helical Traction Vacuum Train-Lighting Lamps.

London & North-Eastern Railway Company (Great Eastern Section).—Supply of Train-Lighting Lamps.

Booth Steamship Company.—Supply of lamps for the whole of 1925.

Admiralty.—A large quantity of SIEMENS Electric Lamps, Vacuum, Gasfilled, and Traction (Vacuum) types for immediate delivery.

The Royal Mail Steam Packet Co. have accepted tender for the whole of their requirements for Electric Lamps (Vacuum and Gasfilled) for the first six months of 1925.

The Aberdeen Line (Proprietors, Messrs. George Thompson & Co., Ltd.).—Supply of electric lamps for the six months ending June 30, 1925.

The General Electric Co., Ltd., inform us a recent contract from the *Admiralty* includes the supply of 5,800 Osram lamps.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

LIGHTING IN RELATION TO PUBLIC HEALTH, *by Janett Howell Clarke (Balliére, Tindall & Cox, 8, Henrietta Street, Covent Garden, London, W.C.2., 20s. net, 185 p.p., 65 Figs., 1924).*

This work is of American origin, but is obtainable in this country, as indicated above. In the introduction the author, who is an Associate Professor of Physiological Hygiene in the Johns Hopkins University, explains that her object is to present information on lighting suitable for the needs of the public health worker. The initial chapters on units and standards, measurement of illumination, etc., cover fairly familiar ground. The chapter on "Sufficient Illumination" is noteworthy for the table of values, as recommended in 1914 and 1921. During these seven years the standards of illumination for all the purposes specified have increased, and in some cases more than doubled (e.g., in classrooms of schools, 8 as compared with 2-3 ft.-c.). This point is illustrated by diagrams showing the relation between visual acuity and illumination. In a subsequent chapter this subject is again treated. It is suggested that whereas the increase in acuity with increasing illumination reaches a maximum at about five foot-candles, the speed of reading still continues to increase. This is a point one would like to see tested in this country. In the chapter on "Glare," the author, after quoting somewhat elaborate investigations, confesses that it is difficult to reduce results to a concrete form. However, in the sections on Lighting Legislation, the tabular data adopted in the United States codes for dealing with this problem are reproduced. To British readers the information on American codes of lighting schools and factories will be useful. Of special interest also is the chapter on "Occupational Eye Diseases due to Low Illumination." Attention is drawn to the tendency towards increased myopia of children during school life. This is believed to be accentuated by inadequate illumination. The author deals in some detail with miners' nystagmus, another ocular disease believed to be caused mainly by insufficient light, and summarises the results of the discussion on this subject before the Illuminating Engineering Society in London. It is satisfactory to find a book on illumination addressed specifically to public health officers; we should say that if they grasp the contents of this work, they will have a tolerably wide knowledge of the subject.

SUNLIGHT AND HEALTH.—The attention of our readers may be drawn to an interesting development, illustrated by the publication of a number of special treatises—the relation between sunlight and health, and in particular the use of ultra-violet rays in medical treatment. "Artificial Sunlight and its Therapeutic Uses," by Dr. F. H. Humphris (Oxford University Press), and "Ultra-violet Rays in the Treatment and Cure of Disease," by Dr. Percy Hall (William Heinemann) are instances. This is a field of work of considerable interest to the illuminating engineer.

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